IC-701

HF ALL BAND ALL SOLID STATE TRANSCEIVER

INSTRUCTION MANUAL

ICOM

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SECTION I SPECIFICATIONS

GENERAL

Number of Semi-Conductors:

Transistors	128
F E T	23
IC (Includes LSI)	56
Diodes	265

Frequency Coverage:

1.8MHz ~ 2.0MHz
3.5MHz ~ 4.0MHz
7.0MHz ~ 7.5MHz
(7.3MHz~7.5MHz Receive Only)
14.0MHz~15.2MHz
(14.35MHz~15.2MHz Receive Only)
21.0MHz~21.5MHz
28.0MHz~30.0MHz (28.0MHz~29.7MHz Transmit Range)

Frequency Control:

LSI based 100Hz step Digital PLL synthesizer.
Independent Transmit-Receive Frequency Available on same band.

TRANSMITTER

DC Input Power:

SSB (A_3J)	200 Watts
CW (A_1), RTTY (F_1)	200 Watts

Continuously Adjustable Output power 0~Max.

Emission Mode:

A_3J	SSB (Upper sideband and Lower sideband)
A_1	CW
F_1	RTTY (Frequency Shift Keying)

Harmonic Output:

More than 40dB below peak power output

Spurious Output:

More than 60dB below peak power output

Carrier Suppression:

More than 40dB below peak power output

Unwanted Sideband:

More than 40dB down at 1000Hz AF input

Microphone:

Impedance 600 ohms
Input Level 10 millivolts typical
Dynamic or Electret Condenser Microphone

Frequency Readout:

6 digit LED 100Hz readout.

Frequency Stability:

Less than 500Hz after switch on 1 min to 60 mins, and less than 100Hz after 1 hour. Less than 1KHz in the range of−10°C to +60°C.

Power Supply Requirements:

DC 13.6V ±15% Negative ground Current drain 18 A max. (at 200W input)
AC power supply speaker console is available for AC operation.

Antenna Impedance:

50 ohms Unbalanced

Weight:

7.3Kg

Dimensions:

111mm x 241mm x 311mm (H x W x L)

RECEIVER

Receiving System:

Triple Conversion Superheterodyne with continuous Bandwidth Control

Receiving Mode:

A_1, A_3J (USB, LSB) F_1 (Output FSK audio signal)

IF Frequencies:

1st	9.0115MHz
2nd	10.75MHz
3rd	9.0115MHz

with continuous Bandwidth Control

Sensitivity:

Less than 0.25 microvolts for 10dB S+N/N

Selectivity:

SSB. RTTY	±1.2KHz at −6dB
	(Adjustable to ±0.5KHz Min)
	±2.0KHz at −60dB
CW	±250Hz at −6dB
	±700Hz at −60dB
CW-N	±100Hz at −6dB
	±500Hz at −60dB (with Audio Filter)

Spurious Response Rejection Ratio:

More than 60dB

Audio Output:

More than 1.5 Watts

Audio Output Impedance:

8 ohms

SECTION 2 FEATURES

ALL BAND, ALL MODE, ALL SOLID STATE

The IC-701 covers all the Amateur HF frequencies from 1.8MHz to 29.999.9MHz plus 15MHz WWV. It offers not only SSB, but also CW and RTTY. All of the circuits in the IC-701, including the driver and final power stages are completely solid state, and provide about 100 Watts output.

COMPUTER COMPATIBLE TUNING SYSTEM

The local oscillator circuit (VFO) employs a C-MOS LSI for the PLL that has been custom-made on the basis of ICOM's advanced digital technology. The VFO circuit is a digital PLL circuit that controls frequency determination by pulses produced by the tuning control. Unlike conventional PLLs, it controls the VCO by combining and dividing crystal oscillator frequencies. Therefore, its stability is much higher than conventional VFOs. In addition, the pulse control system makes it possible to set and change frequencies with external digital signals.

With a computer programmed and connected to the rear accessory socket, you can easily control frequencies, change bands, scan, on the IC-701. This system will give you the maximum of performance and versatility.

DUAL DIGITAL VFO'S

The IC-701 contains two built-in digital VFO's located in ICOM's custom LSI, providing the ultimate in versitility.

DIGITAL READOUT AND FULL METERING

The frequency is presented in bright easy to read LEDs, with no backlash or waiting time. The mulit-function meter shows you relative signal strength in receive, power output, ALC, SWR, compression level, final transistor voltage and current. All the important information you need to know.

PASS BAND TUNING AND SPEECH PROCESSOR

The IC-701 has a built-in Pass Band Tuning system developed by ICOM that allows you to continuously adjust the pass band of the IF. By turning the control, you can eliminate interference from a nearby signal, thus providing clear reception. It can also be used as a tone control. During transmit, the Pass Band Tuning circuit can be used as a Speech Processor providing increased "talk power" for outstanding DXing.

OUTSTANDING PERFORMANCE

The RF amplifier circuit using MOS FETs, the Schottky barrier diode balanced mixer and other circuits provide excellent Cross Modulation and Two-Signal Selectivity characteristics. The IC-701 has excellent sensitivity demanded especially for mobile operation, high stability, and with two Crystal Filters having high shape factors, exceptional selectivity.

The Same Schottky diode mixer is used in the transmitter, and, with the band pass filter and high performance K-Constant two stage low-pass filter, ensures transmission of pure signals with very low spurious emission.

ADDITIONAL CIRCUITS

The IC-701 has a built-in Noise Blanker, VOX, an Auto Dimmer for control of the readout and meter illumination, CW Monitor, APC, SWR detector, and many other circuits for your convenience.

The IC-701 has everything you need to really enjoy HF operation, in an extremely compact, rugged transceiver.

SECTION 3 INSTALLATION

BE SURE TO READ THE FOLLOWING INSTRUCTIONS BEFORE USE.

3 - 1 UNPACKING

Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any be apparent, notify the delivering carrier or dealer immediately, stating the full extent of the damage. It is recommended you keep the shipping cartons. In the event storage, moving, or reshipment becomes necessary they will be handy. Accessory cables, plugs, etc., are packed with the transceiver. Make sure you have not overlooked anything.

1. Microphone (IC-SM2) 1
2. External Speaker Plug 1
3. Key Plug 1
4. Scope Terminal Plug 1
5. Transverter terminal Plug 1
6. Spare Fuse (20 Amp) 2
7. DC Power Cord 1
8. Accessory Plug (24 Pin) 1
9. Accessory Plug Pins 24
10. Accessory Plug Boot 1

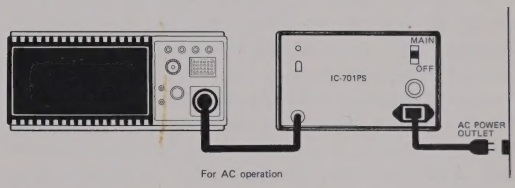
3 - 2 RECOMMENDATIONS FOR INSTALLATION

1. Avoid placing the IC-701 in direct sunlight, high temperature, dusty or humid places.
2. The left side of the unit, when facing it, functions also as a heatsink. The temperature there will usually become relatively warm during transmission. Any equipment should be at least 1 inch (3cm) away from the unit so as to provide good ventilation. Be sure that nothing is on and just behind the rear PA heatsink to ensure good ventilation. Also avoid places near outlets of heaters, air conditioners etc.
3. Place the unit so that the controls and switches can easily be handled and the frequency indication and meter can easily be read.
4. For mobile installation, an optional mounting bracket is available. Select the best location that can stand the weight of the unit and that does not interfere with your driving in any way.
5. Use the Ground Lug!

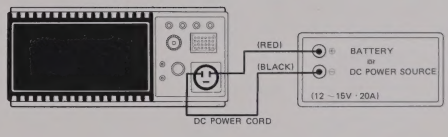
3 - 3 POWER SUPPLY

For AC operation, use the special power supply IC-701PS. If you would like to use your car battery or any other DC power supply, be sure that its output voltage is 12-15 Volts and the current capacity is at least 20 Amps. The maximum power consumption of the set during transmission runs from 16-20 Amps, so keep that in mind if the unit is installed in your automobile, and turn it on after you have started the engine. Attention should also be paid to the condition of the battery and electrical system.

The connection of the DC power cord supplied with the IC-701 is done in the following way: First make sure that the power switch of the unit is in the OFF position and the T/R switch is in the receive position. Connect the cord to the DC power supply with the RED lead to the positive terminal and the BLACK lead to the negative terminal. (Reverse connection will cause the protection circuit to operate and blow the fuse.) Connect the DC plug to the socket on the rear panel of the IC-701. Refer to the drawing below.



For AC operation



For DC operation

3 - 4 ANTENNA

Antennas play a very important role in radio communication. If the antenna is inferior, your transceiver cannot give you the best performance. With a good antenna and feeder cable having 50 ohm impedance, you should easily get the desired matching and performance. Carefully install a high performance antenna that suits the frequency band(s) you wish to operate on and place it as high as possible. Be especially careful of the condition of the connectors as loose connections will deteriorate the performance. Be sure to connect the ground terminal of a whip antenna, if used, to the body of your car.

As the output is quite high, avoid connecting the antenna connector to open lines and do not transmit under mismatched conditions. Otherwise the final stage could be overloaded and cause a malfunction of the unit.

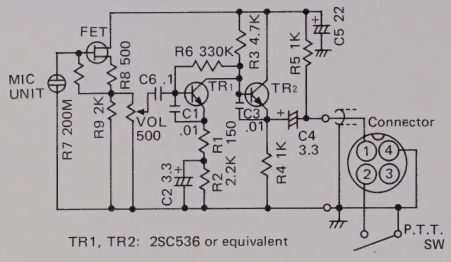
3 - 5 GROUND

In order to prevent electrical shocks, TVI, BCI and other problems, be sure to connect a heavy wire ground, as short as possible, from a good earth point to the ground terminal on the rear panel.

3 - 6 MICROPHONE

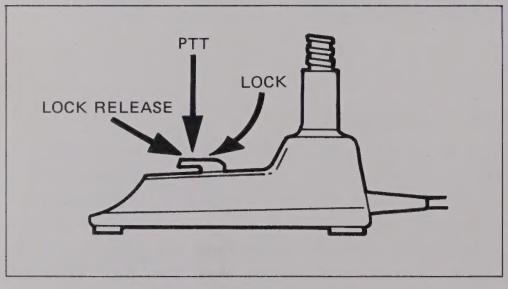
The microphone supplied with the IC-701 is the IC-SM2 which contains a pre-amplifier. It's circuit diagram is shown below. The IC-SM2 is an Electret Condenser type microphone.

Schematic diagram of IC-SM2

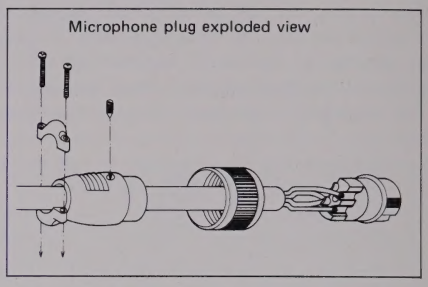


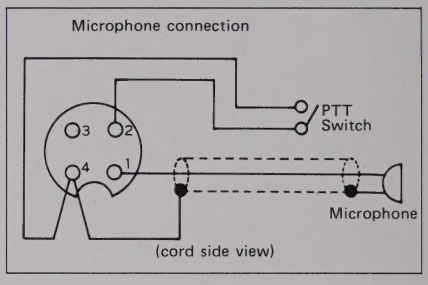
TR1, TR2: 2SC536 or equivalent

A sensitivity control is installed on the bottom side of the mic stand. By turning it in the "H" or "L" direction, the sensitivity will increase or decrease respectively. Adjust the control so as to get the proper sensitivity considering the distance to the mic, the loudness of your voice and the environmental conditions. The wind screen not only prevents background noise due to wind, but also protects the mic. Unless required, do not remove the screen from the mic. In order to operate the microphone, connect its plug to the mic socket on the IC-701. To transmit, press the PTT switch downward. When it is released, the IC-701 will return to the receive condition. For a long transmission, pull the PTT switch back while pressing it down until the switch is locked and it will remain in that position until it is pushed forward and released.



If you would like to use a different microphone in your car, an optional hand held dynamic microphone is available. If other types of microphones are used, be sure their impedance is between 500-600 ohms, and connect a 4 pin plug in the manner shown.





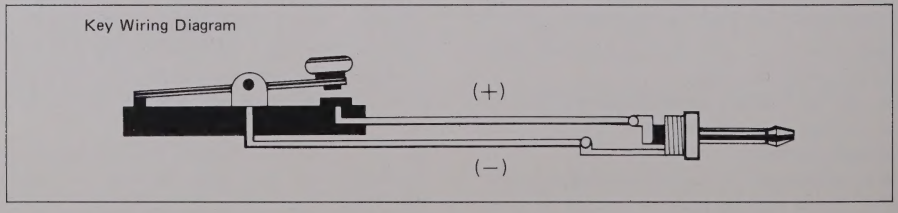
3 - 7 CW KEY

When operating CW, connect the Key to the Key Jack with the plug supplied. The connection of the plug is shown below.

If the terminals have polarity, be sure to make the correct connection. Note that the keyed voltage when switching with semiconductors or relays with resistors in the circuit, should be adjusted to be below 0.4 Volts!

3 - 8 RTTY

When operating RTTY, connect the ACC socket pins 8 (ground) and 9 to your tele-typewriter through a high speed relay or a level converter to TTL level, and the tones for your terminal unit will be available from pin 4. For details, refer to "How to use RTTY", and "Transmit and Receive" sections in this manual.



3 - 9 EXTERNAL SPEAKER

The IC-701 contains an internal speaker, and is also designed so that it can drive an external speaker from the external (EXT) speaker jack on the rear panel. Be sure the impedance of the external speaker is 8 ohms, and remember that with the external speaker connected, the internal speaker is disabled.

3 - 10 HEADPHONES

Any good headphone set, including stereo type, that have 4-16 ohms impedance can be used. With the plug inserted halfway into the PHONES jack, both the headphone and speaker will operate. This is convenient when others wish to listen in on the station, or you wish to record contacts using a tape recorder connected to the headphone jack. With a stereo headphone set inserted this way, however, the headphone will lose the sound on one side. With the plug inserted completely, only the headphone works.

3 - 11 POWER SUPPLY

It is highly recommended that you use the IC-701PS power supply for base operation. If you wish to use another power source, make sure that it meets the voltage, current, and regulation requirements. Pay particular attention to the overvoltage protection as a runaway regulator can destroy the IC-701. Make certain that more than 18 Volts does not get applied to the unit. When the power switch is in the ON position, do not connect the power cord, antenna, external speaker, Accessory plug, or the microphone to avoid possible trouble. Be sure not to transmit with the antenna disconnected. If the fuse blows, replace it with a new 20 Amp fuse after fixing the cause. Avoid turning the power switch ON and OFF repeatedly over a short time. Frequent repetitions may cause the frequency indicator to display the wrong frequencies. If such a malfunction should occur, turn OFF the switch and a few seconds later turn it ON again.

3 - 12 CAUTIONS

As the unit has already been closely adjusted with highly sophisticated measuring instruments, never tamper with the turnable resistors, coils, trimmers, etc.

IN THE PLL UNIT, THE HEART OF THE TRANSCEIVER, A C-MOS LSI IS INCORPORATED. IF THE SEAL IS BROKEN WHEN A FAILURE OCCURS WITHIN THE TERMS OF THE GUARANTEE, THE REPAIR MAY BE AT THE USERS EXPENSE, SO DO NOT ATTEMPT TO OPEN THE PLL CASE!

C-MOS is also used in the digital driver unit as well as the PLL. C-MOS ICs are very susceptible to excessive static charges and over current and care must be used when handling them. Therefore, avoid touching the driver unit and the nearby circuitry unless absolutely necessary. When it is necessary to check the circuitry, observe the following points.

Ground all measuring instruments, the soldering iron, and other tools. Do not connect or disconnect the C-MOS IC from its socket, or solder it when the power is ON. Do not apply voltage of less than –0.5 or more than +5 Volts to the input terminals of the IC. DO NOT MEASURE WITH AN OHMMETER.

3 - 13 COOLING FAN

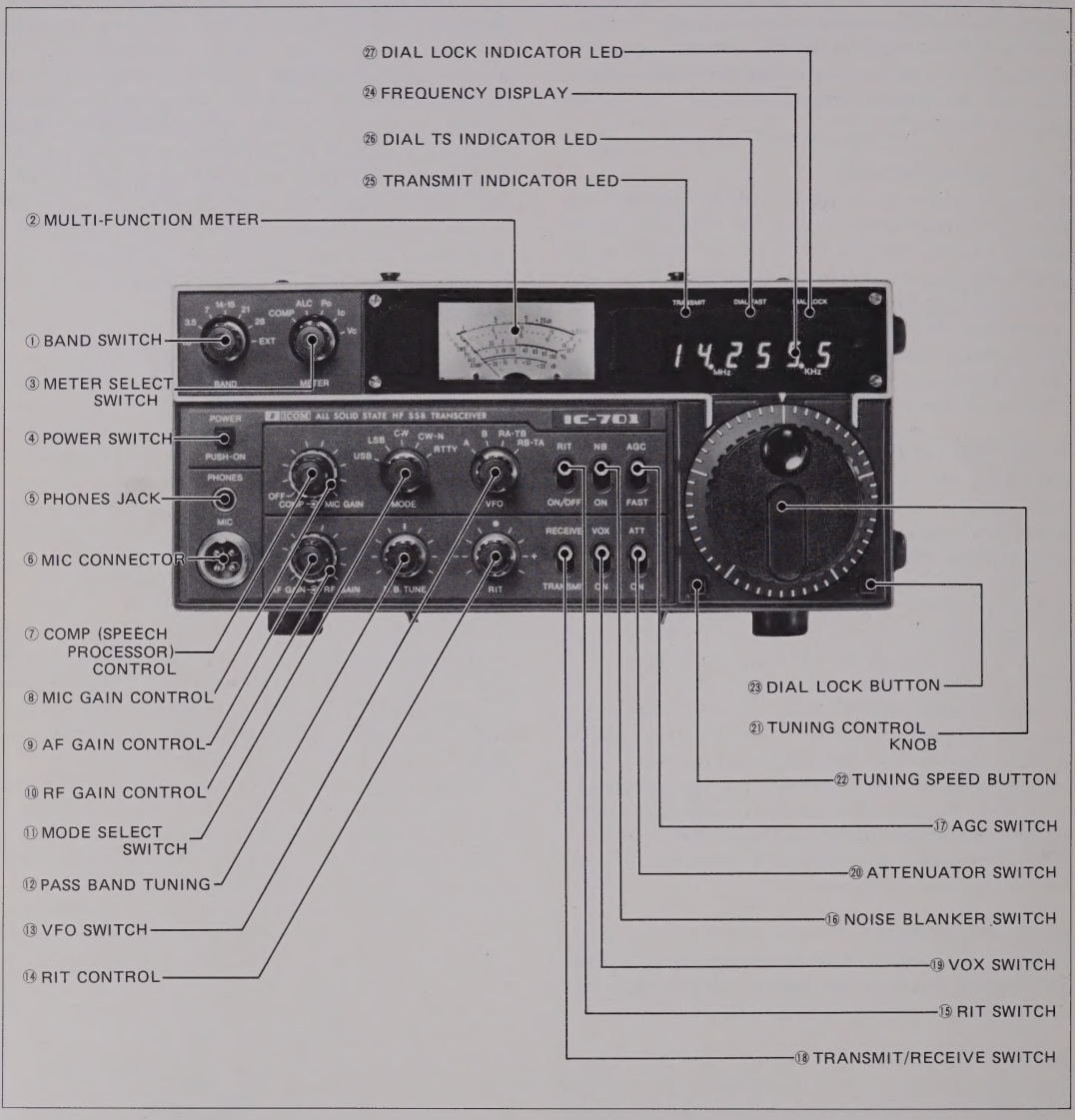
The rear of the PA unit is designed to achieve effective natural cooling. But with 200 Watts input, the final stage circuit produces quite a bit of heat and its temperature may rise during a very long, continuous transmission. If the temperature becomes high enough, the built-in cooling fan will start to spin. The fan is connected to the temperature monitoring circuit which detects the temperature of the final stage transistors. The operation of this fan is as follows:

1. The fan does not work during all reception.
2. During transmission, it does not work if the detected temperature is below a certain level.
3. When the temperature exceeds that level during a transmission, the fan will start to move air across the heatsink to cool it.
4. If the temperature of the final stage transistors rises to the danger point, the fan will turn at a much higher speed and frequency display will start to flash. THIS MEANS STOP TRANSMITTING!

1, 2 and 3 are normal conditions. 4 is abnormal. If the meter and display start to flash, stop transmitting and check for the cause of the excess heat. This could be antenna mismatch, environmental problems, etc., but be sure to rectify the problem before beginning to operate again.

SECTION 4 OPERATING CONTROLS

4 - 1 FRONT PANEL



1. BAND SWITCH

The BAND SELECT SWITCH is a 7 position rotary switch used for selecting one of the 6 Amateur bands covered by the IC-701 with a 7th position for external control. The selectable bands are 1.8MHz, 3.5MHz, 7MHz, 14MHz, 21MHz and 28MHz. In the EXT position, the band can be selected remotely. However, the switch should not be put in the EXT position without having the remote control connected. This will cause the rotary switch to rotate continuously and may cause excessive wear or damage.

2. MULTI-FUNCTION METER

With the IC-701 in the receive mode, this meter acts as an S meter regardless of the position of the meter select switch. Signal strength is indicated on a scale of S1-S9 and S9+20dB to S9+60dB.

In the transmit mode, the meter has 5 functions as outlined below which are selected by the meter select switch.

3. METER SELECT SWITCH

In the transmit mode the meter has 5 functions.

1. Vc Indicates the collector voltage of the final transistors.
2. Ic Indicates the collector current of the final transistors.
3. Po Indicates the relative output power. SWR can

be measured by placing the SWR/SWR SET switch in the SWR position. (This switch is located under the access cover on the top of the IC-701.

4. ALC In this position, the meter begins to function when the RF output power reaches a certain level.

5. COMP Indicates the compression level when the speech processor is in use.

4. POWER SWITCH

The POWER SWITCH is a push-lock type switch which controls the input DC power to the IC-701. When the external AC power supply (IC-701PS) is used, the switch also acts as the AC power supply switch. When the switch is pushed in and locked, power is supplied to the set. When the switch is pushed again and released, power is cut to all circuits except the PA unit.

5. PHONE JACK

This jack accepts a standard 1/4 inch headphone plug for a 4-16 ohm headphone set. Stereo headphones can be used without modification.

6. MIC CONNECTOR

Connect the supplied microphone or optional microphone to this jack. If you wish to use a different microphone than the IC-SM2, refer to the drawing on page 4. Microphone impedance should be 500-600 ohms.

7. COMP (SPEECH PROCESSOR) CONTROL

The IC-701 contains a built-in RF speech processor which is turned ON by turning the center knob clockwise from the OFF position (a click will be heard). In the ON position it works as the RF drive control as explained below. In the CW and RTTY modes, it works as the output level control of the IC-701. When RF speech processor operation is not desired, the COMP control should be turned completely counter-clockwise and clicked OFF.

8. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. Clockwise rotation increases microphone gain. As the input will vary with different microphones and different voices, the knob should be turned until the MULTI-FUNCTION METER needle, in the ALC mode, starts to move slightly within the ALC zone. In the SSB mode, with the RF speech processor in use, the MIC GAIN CONTROL sets the clipping limits, while the COMP control sets the RF drive level up to the maximum power level where ALC begins at the saturation point of the amplifiers.

9. AF GAIN CONTROL

Controls the audio output level in the receive mode. Clockwise rotation increases audio output.

10. RF GAIN CONTROL

Controls the gain of the RF section in the receive mode. Clockwise rotation gives the maximum gain. As the control is rotated counter-clockwise, the needle of the MULTI-FUNCTION METER rises, and only signals stronger than the level indicated by the needle will be heard.

11. MODE SELECT SWITCH

This switch selects the mode of operation for both transmit and receive.

USB Upper Sideband, mainly for 14, 21 and 28MHz bands.

LSB Lower Sideband, mainly for 1.8, 3.5 and 7MHz bands.

CW Continuous Wave, for CW operation on all bands.

CW-N Narrow CW. The audio band-pass filter is automatically turned ON in this position to improve selectivity when receiving.

RTTY Radio Teletype. For use on all available bands.

12. P. B. TUNE (PASS BAND TUNING) CONTROL

This control allows continuous tuning of the pass band selectivity moving the edge of the filter up to 1.5KHz from either the upper or lower side in SSB and RTTY. This not only improves selectivity, but also can improve the audio quality. The normal position is in the center (12:00 o'clock) position and is 2.4KHz wide in SSB.

13. VFO SWITCH

With this switch you can select the VFO you want to operate from two separate VFO's that are built-in to the IC-701. It also selects the relationship of the two VFO's. The switch performs the following operations according to its position.

* A : Selects "A" VFO for both transmit and receive.
* B : Selects "B" VFO for both transmit and receive.
* RA-TB : Selects "A" VFO for receive and "B" VFO for transmit.
* RB-TA : Selects "B" VFO for receive and "A" VFO for transmit.

In addition, when the VFO is switched from "A" VFO to "B" VFO, the frequency indicated on the frequency display just prior to switching goes into a memory inside the LSI. Thus even if "B" VFO is being used, switching to "A" again will enable you to operate at the initial frequency. Switching from "B" to "A" results in the same operation. However, if switching is done with the BAND SWITCH (or external control), the VFO frequency displayed will disappear and the lower end frequency of the band selected will be displayed. If you wish to operate on the frequency that was memorized in the VFO that was not used when switching bands, simply return to the original band and then to the other VFO and the initiall memorized frequency will appear. This is explained in more detail later in this manual.

14. RIT CONTROL

Shifts the receiver frequency ±800Hz either side of the transmit frequency. When the RIT is ON, the RIT LED is illuminated. The LED also represents the "0" position. Rotating the control to the (+) side raises the receiver frequency, and rotating to the (−) side lowers the receiver frequency. With the RIT ON, if the tuning knob ㉑ is moved one increment, the RIT circuit is automatically pulsed OFF. Therefore it is not necessary to manually turn

OFF the RIT when changing operating frequency. The frequency shift by tuning the RIT Control is not indicated on the frequency display.

15. RIT SWITCH
This is a spring-loaded switch for the RIT control. To turn ON the RIT, push down once. If OFF is desired, push down again. When the RIT is ON the LED above the RIT control knob is lit. This also indicates the center position of the RIT control. With the RIT circuit OFF the LED is also OFF. Also if the RIT is ON and the Tuning Knob is rotated one increment it will pulse the RIT OFF unless the internal jumper has been changed.

16. NB (NOISE BLANKER) SWITCH
When pulse type noise such as automobile ignition noise is present, set this switch to the ON (down) position. The noise will be reduced to provide comfortable reception.

17. AGC (AUTOMATIC GAIN CONTROL) SWITCH
With this switch you can change the time constant on the AGC circuit. With the switch in the AGC (up) position, the circuit operates as a "hang" AGC and maintains the AGC voltage for a specific time, thus it is suitable for SSB reception. With the switch in the FAST (down) position, the circuit is OFF, and AGC is suitable for stations suffering from fast fading or operating in the CW mode.

18. TRANSMIT/RECEIVE (T/R) SWITCH
This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (up) and the IC-701 is in the receive mode. Set the switch to TRANSMIT (down) and it switches to transmit. When switching with the PTT switch on the microphone or with the VOX switch set to ON the T/R switch must be in the RECEIVE position.

19. VOX SWITCH
This switches the VOX circuit ON and OFF. When it is in the ON (down) position, in SSB, T/R switching is accomplished by means of a voice signal. In CW operation, semi-break-in switching by means of keying is possible.

20. ATT (ATTENUATOR) SWITCH
Turn the ATT switch ON (down) when strong nearby signals disturb signal reception or make "S" readings difficult. In the ON position, a 10dB attenuator is inserted into the receiving antenna circuit, reducing interfering signals and giving more stable reception. In normal operation the ATT switch is left in the OFF (up) position.

21. TUNING CONTROL KNOB
Rotating the TUNING CONTROL KNOB clockwise increases the frequency, while rotating it counter-clockwise decreases the frequency. The frequency is changed in 100Hz steps which correspond to the smaller vernier marks on the knob. The larger marks represent 1KHz steps. One complete rotation of the tuning knob results in a 5KHz frequency increase or decrease in 100Hz steps exactly as shown by the small vernier marks.

22. TUNING SPEED BUTTON
Pushing the TUNING SPEED BUTTON will illuminate the DIAL FAST display LED, and the small vernier marks on the tuning knob are changed to correspond to 10KHz steps. At the same time, the 1KHz and 100Hz digits are cleared on the display to show "0.0". When the Tuning Speed Button is depressed again, the dial fast display LED goes OFF and the small vernier marks will again correspond to 100Hz steps. This button will allow you to quickly QSY over a great frequency range.

23. DIAL LOCK BUTTON
After the IC-701 is set to a certain frequency for rag chewing, mobile operation, etc., pushing the DIAL LOCK BUTTON will illuminate the DIAL LOCK display LED and the VFO is electronically locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change frequency, the dial lock must first be disengaged by pushing the dial lock button again. The dial lock display LED will go OFF and the frequency will change with the direction of the tuning knob rotation. Turning the power OFF will release the dial lock and clear the displayed frequency.

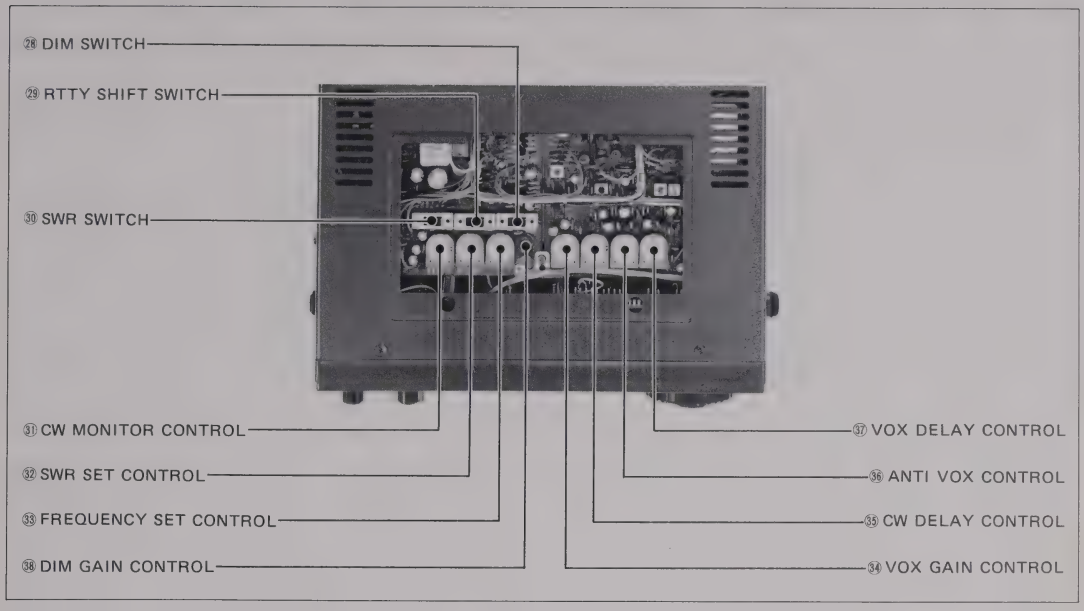
24. FREQUENCY DISPLAY
The frequency of the IC-701 is displayed on 7 segment LEDs. Since the 1MHz and 1KHz decimal points are displayed, the frequency can easily be read. The frequencies indicated are the carrier frequencies of each mode in USB, LSB and CW. In the RTTY mode, the space frequency is displayed. Since the local oscillation frequency is shifted in accordance with modes, no tuning will be required if you change modes. Remember, if you turn the RIT control ON to change the receive frequency and rotate the RIT control knob, the frequency displayed will not change.

25. TRANSMIT INDICATOR LED
When your set is in the transmit mode, this LED is lit.

26. DIAL TUNING SPEED INDICATOR LED
Illuminates when the TUNING SPEED BUTTON is pressed to set the dial to fast tuning.

27. DIAL LOCK INDICATOR LED
Illuminates when the DIAL LOCK BUTTON is pressed to lock the dial.

4 - 2 CONTROLS UNDER ACCESS COVER



28. DIM SWITCH
When this switch is set to DIM, the luminosity of the frequency display and the meter automatically decreases when the ambient level is reduced below a set level. Therefore, under dim lighting such as at night, it decreases the luminosity to a lower level for easy indicator reading. When the switch is at the OFF position, the dimmer function is disabled.

29. RTTY SHIFT SWITCH
This switch shifts transmit frequency and shift spacing. Normally the shift is 170Hz, but in some cases 850Hz is still used. Set the switch for the desired shift.

30. SWR SWITCH
When measuring SWR, calibration SET and SWR reading functions are selected with this switch. Remember, at the factory, the switch is in the SET position and fixed in place with a plastic screw to prevent it from switching to SWR. Remove the screw before attempting to read SWR! SWR must be read only in the Po meter position.

31. CW MONITOR (MONI) CONTROL
This control adjusts the audio volume of the side tone (monitor) audio during CW transmit operation. Adjust it to your desired level for easy listening.

32. SWR SET CONTROL
This control calibrates the meter needle to the Po SET position when you want to determine the value of SWR. The meter must be in the Po position and the set must be transmitting a carrier.

33. FREQUENCY SET CONTROL
This control is for fine adjustment of the VXO section frequency of the PLL unit, which is the local oscillator frequency. Do not turn it unless you want to change the frequency.

34. VOX GAIN CONTROL
This control adjusts input signal level via the microphone to the VOX circuit. For VOX operation in SSB, adjust the control so that the VOX circuit will operate with normal speech.

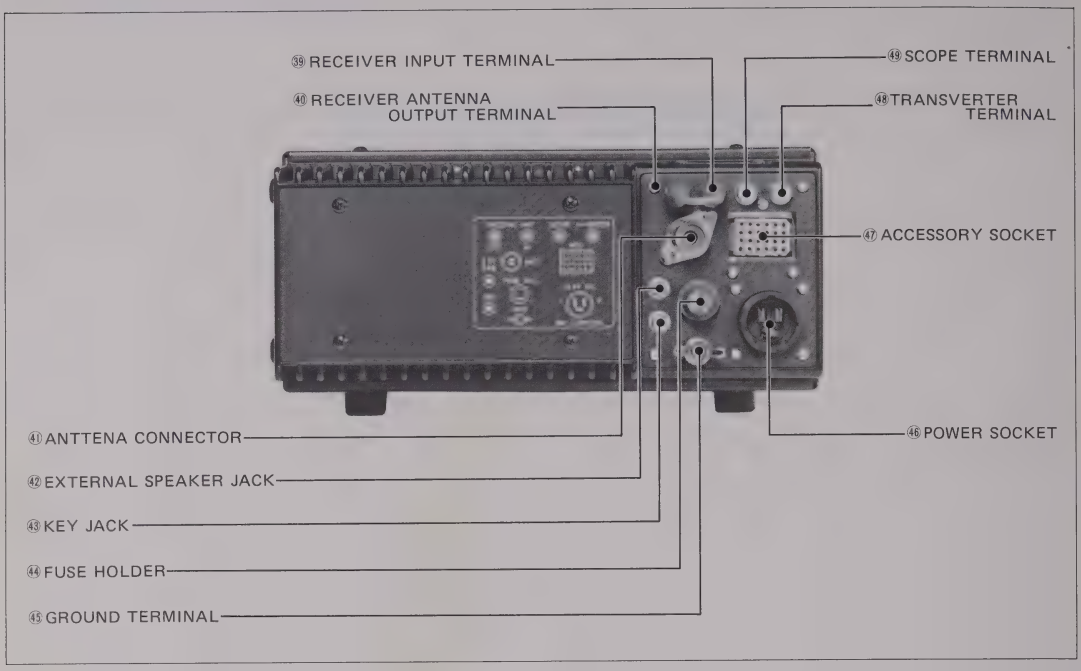
35. CW DELAY (CW time delay constant) CONTROL
In Semi-break-in CW operation, this controls the TX/RX switchover time delay. Adjust it to suit your keying speed.

36. ANTI VOX CONTROL
In VOX (SSB) operation, the VOX circuit may be operated by sound from the speaker causing a switch to transmit. This trouble can be prevented by adjusting the input level of the ANTI VOX circuit with this control along with the VOX gain control so that the VOX circuit only operates from the operator's voice, not by sound from the speaker.

37. VOX DELAY (VOX time constant) CONTROL
This controls the TX to RX switching time. Adjust it so TX to RX switching will not occur during short pauses in normal speech.

38. DIM GAIN (dimmer circuit) CONTROL
The threshold for the functioning of the dimmer circuit can be adjusted by turning the DIM GAIN CONTROL. Turning the control counter-clockwise will lower the operation threshold of the circuit.

4-3 REAR PANEL CONNECTIONS



39. RECEIVER INPUT TERMINAL

This is an input terminal which is connected directly to the receiver.

40. RECEIVER ANTENNA OUTPUT TERMINAL

This is a terminal to which received signals from the antenna connector are conducted after the signal passes through the transmit/receive antenna switching circuit. Usually the receiver IN and OUT terminals are jumpered. The receiver antenna output terminal is usually used when another receiver is used or a pre-amplifier is connected to the IC-701.

41. ANTENNA (ANT) CONNECTOR

This is used to connect the antenna to the set. Its impedance is 50 ohms and connects with a PL 259 connector.

42. EXTERNAL SPEAKER JACK

When an external speaker is used, connect it to this jack. Use a speaker with an impedance of 8 ohms. When the external speaker is connected, the built-in speaker does not function.

43. KEY JACK

For CW operation, connect the key here. For electronic keying the terminal voltage must be less than 0.4V DC.

44. FUSE HOLDER

This holds the fuse for the DC power circuit. If the fuse is blown, replace it with a new 20 Amp fuse after checking the cause. Open the fuse holder with a Phillips head driver.

45. GROUND TERMINAL

To prevent electrical shock, TVI, BCI and other problems, be sure to ground the equipment through the GROUND TERMINAL. For best results use as heavy a gauge wire or strap as possible and make the connection as short as possible, even in mobile installations.

46. POWER SOCKET

Connect the DC power cord or cable from the IC-701PS or suitable DC source to this connector.

47. ACC (ACCESSORY) SOCKET

Accessories and controls can be used with the IC-701 and connected to the ACC socket on the rear panel. NOTE: Pins 14-24 are terminals for digital control and are connected to the input terminal of the C-MOS IC. By no means apply any voltage not within the range of –0.5 to +5 Volts. For details, refer to page 20.

48. X-VERTER (TRANSVERTER) TERMINAL

VHF and UHF operation using a suitable transverter with the IC-701 is possible. This terminal is for Transverter connection. The output is a few milliwatts. Refer to the tranverters instruction for recommended hookup.

49. SCOPE TERMINAL

This terminal brings out the 9.011MHz IF signal from the mixer in the receiver. Not only observation of the received signal, but also of signals of a the selected band width are possible by using a panadaptor or panascope.

SECTION 5 OPERATING INSTRUCTIONS

5-1 HOW TO TUNE

The following instructions are for tuning in any mode. Please read carefully and understand fully before turning on your unit. Proper tuning is necessary for optimum operation.

5-1-1 TUNING KNOB

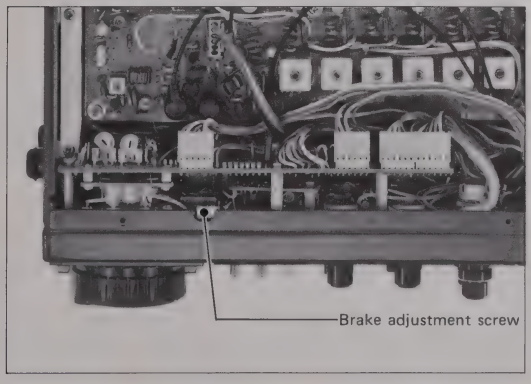
The transmit or receive frequency is displayed on 7 segment LEDs down to 100Hz digits. Rotating the tuning knob clockwise increases the frequency, while turning counter-clockwise decreases the frequency in 100Hz steps. The smaller vernier marks on the knob represent 100Hz and the larger marks represent 1KHz. One complete rotation of the tuning knob results in a 5KHz frequency increase or decrease. When you receive your set, calibration of the tuning knob may be desirable, as the large increments may not correspond exactly to a change of 1KHz displayed on the LEDs. Exact calibration is not necessary as the displayed LED frequency will always be correct, but you may calibrate the scale on the tuning knob for use as an analog type frequency display. To calibrate, set a large increment on the tuning scale to line up with the indicator arrow directly above the scale and then turn ON the power.

To calibrate the scale during operation, if desired, set a large increment on the tuning scale to line up with the indicator arrow and then push the tuning speed button TWICE. By doing so, the 1KHz and 100Hz digits are cleared on the display to show "0.0".

The tuning knob scale may require recalibration if you:

1. Turn the knob while the frequency is locked by use of the Dial Lock Button.
2. Use the tuning speed button when a large increment is not lined up with the indicator.
3. Turn the knob beyond the band edge.

If the knob is too loose or too stiff for comforatble use, you can adjust the torque by tightening or loosening the brake adjustment screw accessable from underneath the set.



Brake Adjustment

The following instructions should be used to adjust the tension of the Tuning Knob.

1. Remove the bottom cover of the IC-701.
2. The Tuning knob tension will become tighter by turning the brake adjustment screw clockwise, and will become looser by turning the screw counterclockwise.
3. While performing this adjustment, the Tuning knob must be turned continuously as the screw is adjusted in order to set the tension for a comfortable touch.
4. After the adjustment has been made, replace the bottom cover.

On all but the 28MHz band, the displayed frequency will not go beyond the highest band edge even by turning the tuning knob clockwise, or beyond the lowest band edge by turning the knob counter-clockwise. On the 28MHz band, since this band width is much wider than the others, the IC-701 provides "automatic revert" for operating convenience. When the frequency display shows 29.999.9MHz and the tuning knob is turned clockwise, the displayed frequency jumps down to 28.000.0MHz and continues up from there. Likewise, by continuing to turn counter-clockwise beyond the bottom edge of the band, the frequency jumps up from 28.000.0MHz to 29.999.9MHz and goes down from that point.

The displayed frequency shows the carrier frequency in the USB, LSB and CW modes, and the SPACE frequency in the RTTY mode. Therefore recalibration of the frequency is unnecessary when the mode is changed.

5-1-2 DIAL LOCK BUTTON

After the IC-701 is set at a certain frequency for rag chewing, mobile operation, etc., pushing the Dial Lock button will illuminate the Dial Lock LED and the VFO is locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change the frequency, the Dial Lock must first be disengaged by pushing the dial lock button again. The Dial Lock display LED will go OFF, and the frequency will change with the direction of the tuning knob rotation. Turning OFF the power will release the Dial Lock and clear the displayed frequency.

5-1-3 TUNING SPEED BUTTON

Pushing the Tuning Speed Button will illuminate the dial fast LED and the small vernier marks on the Tuning Knob is changed to correspond to 10KHz steps. At the same time, the 1KHz and 100Hz digits are cleared on the display to show "0.0". When the Tuning Speed Button is depressed again, the dial fast display LED goes OFF and the small vernier marks will again correspond to 100Hz steps. This button will allow you to quickly QSY over a great frequency range.

5-1-4 VFO SELECT SWITCH

The LSI in the IC-701 contains two "VFO's" for both receiving and transmitting. The VFO's are labeled "A". VFO and "B" VFO and are selectable with the VFO Select Switch. This dual VFO system gives the IC-701 many very convenient features. Please read this section very carefully and perform the operation several times until you are comfortable with the system.

1. "A" VFO is for both transmitting and receiving and is selected by placing the VFO Select switch in the "A" position. The transmit and receive frequency will be controlled by "A" VFO, displayed on the LED frequency readout, and stored in "A" memory.

2. "B" VFO is for both transmitting and receiving and is selected by placing the VFO Select switch in the "B" position. The transmit and receive frequency will be controlled by "B" VFO, displayed on the LED frequency readout, and stored in "B" memory.

3. RA-TB: The receive frequency is controlled by "A" VFO and the transmit frequency is controlled by "B" VFO. Both frequencies are stored in their respective memories, and displayed during their respective operation times ("A" frequency during receive, and "B" frequency during transmit).

4. RB-TA: The receive frequency is controlled by "B" VFO and the transmit frequency is controlled by "A" VFO, the reverse of the above. Again, both frequencies are stored in their respective memories, and displayed during their respective operation times (this time "B" frequency during receive and "A" frequency during transmit).

When the IC-701 is first turned ON, the frequency displayed on the LED readout is the lowest frequency limit of the band selected by the band switch.

FOR EXAMPLE:
If the band switch is set to the 7MHz band, when the set is turned ON, 7.000.0 will be displayed on the LED readout. This will occur whether the VFO switch is in either the "A" or "B" or combination VFO position. Rotating the tuning knob clockwise will increase the frequency in 100Hz steps. Rotating the tuning knob counter-clockwise will decrease the frequency in 100Hz steps. Note: Rotating the knob counter-clockwise immediately after applying power will not lower the frequency as it is already at the lowest limit.

Switching from one VFO to the other VFO does not clear the first VFO. The frequency is retained in the VFO's memory.

EXAMPLE
If 14.125.0MHz is set with "A" VFO, and the VFO switch is set to "B" VFO, the frequency LED readout will show "B" VFO's frequency, but 14.125.0MHz is still stored in "A" VFO's memory. Returning the VFO switch to "A" VFO position, and 14.125.0 will be displayed on the readout. Accordingly, if the switch is placed in the "B" VFO position, the frequency that was set with the "B" VFO will appear. This allows you to set a certain frequency with one VFO, work up and down the band with the other VFO, and periodically check the set frequency simply by switching between "A" and "B" VFO. It also allows you to search for a clear frequency with one VFO, while keeping your operating frequency on the other VFO. When you have found a clear frequency, switch back to your operating frequency, inform the station you are in contact with of the new frequency, and switch back. It's that simple!

The IC-701 will perform this operation even on two different bands. A frequency is set in either "A" or "B" VFO on one band, the VFO switch is set to the other VFO, and the band switch set to any other band you wish to work. When you want to go back to the set frequency, first return to the original band and then to the original VFO and you're back on the set frequency.

FOR EXAMPLE
Set "A" VFO to 14.255.0MHz. Set the VFO switch to "B" VFO. Switch to the 21MHz band. The frequency readout will read 21.000.0MHz. Operate anywhere you wish with "B" VFO. When you want to return to 14.255.0MHz, first switch back to the 14MHz band. Then switch to "A" VFO and the frequency readout will show 14.255.0MHz.

When recalling a memorized frequency be sure to turn OFF the dial fast circuit. If the circuit is not turned OFF, the memorized frequency's 1KHz and 100Hz digits will both revert to "0".

RA-TB/RB-TA
These positions will allow you to operate split transmit/receive frequencies on the same band.

EXAMPLE:
Set "A" VFO to 14.350.0MHz and "B" VFO to 14.255.0 MHz. Then set the VFO select switch to the RA-TB position. 14.350MHz will shown on the readout during receive ("A" VFO) and 14.255.0MHz during transmit ("B" VFO). You are now receiving on 14.350.0MHz and transmitting on 14.255.0MHz.

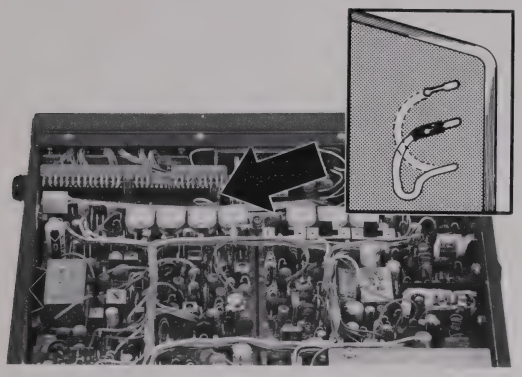
Setting the VFO select switch to RB-TA reverses the above. Changing bands in these modes resets both "A" and "B" VFO to the lowest band limit.

5-1-5 RIT (RECEIVER INCREMEMTAL TUNING)
By using the RIT circuit, you can shift the receive frequency ±800Hz either side of the transmit frequency without moving the transmit frequency itself. Therefore, when you get a call slightly off frequency, or when the other station's frequency has shifted, you can tune in the frequency without disturbing the transmitting frequency. By pushing the RIT switch down once (it's a spring loaded switch) the RIT circuit is turned ON and the RIT LED is lit. The receive frequency is shifted with the RIT knob.

When the RIT knob is in the "0" position, the transmitting and receiving frequencies are the same. Rotating the control to the (+) side raises the receiving frequency, and rotating to the (—) side lowers the frequency. To turn OFF the RIT control, again push on the RIT switch and the RIT LED will go OFF. When the RIT circuit is OFF, the transmit and receive frequencies are the same regardless of

the setting of the RIT control knob.

When the RIT circuit is ON, if the tuning knob is moved by one increment, the RIT circuit is automatically pulsed OFF. However, this function can be eliminated by changing the connecting pins in the driver unit as shown below, in case you would like the RIT to remain operational when you turn the tuning knob. Or, by continuously depressing the RIT switch with your finger while turning the tuning knob, the RIT circuit will remain operational while tuning.



Other things to remember are: The RIT circuit is operational when the frequency is locked with the dial lock button. The frequency shifted by turning the RIT control is not indicated on the frequency display. When the transmitting and receiving frequencies differ by more than 800Hz, use "A" and "B" VFOs as outlined previously.

5-2 SSB OPERATION

5-2-1 RECEIVING:

After connecting an antenna, microphone, etc., set knobs and switches as follows.

POWER SWITCH	OFF
T/R SWITCH	RECEIVE (UP)
VOX SWITCH	OFF (UP)
ATT SWITCH	OFF (UP)
AGC SWITCH	SLOW (UP)
NOISE BLANKER (NB) SWITCH	OFF (UP)
MODE SELECT SWITCH	USB or LSB
VFO SWITCH	"A" or "B"
BAND SELECT SWITCH	Desired Band
AF GAIN CONTROL	Completely Counter-clockwise
RF GAIN CONTROL	Completely Clockwise
P.B. TUNE CONTROL	Center (12 o'clock) position
RIT CONTROL	Center (12 o'clock) position

The other knobs are unrelated to receiving and need not be set at this time.

In SSB operation there is both an USB (upper side band) and an LSB (lower side band). LSB is usually used on the 1.8, 3.5 and 7MHz bands, while USB is usually used on the 14, 21 and 28MHz bands. Select the mode according to the band in which you wish to operate.

Now turn ON the power switch. The meter lamp will be illuminated and the lowest frequency of the selected band will be shown on the LED readout. Slowly turn the AF gain control clockwise to a comfortable level. Rotate the tuning knob until a signal is received. The multi-function meter needle will move according to the signal strength, so tune for the highest possible meter reading and the clearest audio. If you cannot get a clear signal, you may be receiving in the opposite sideband. If so, change the mode switch to the proper sideband.

The VFOs in the IC-701 change in 100Hz steps. Therefore the maximum possible difference in your receiving frequency and the received signal frequency is 50Hz. However, for normal voice signal reception, a difference of 50Hz is negligible and indeed may be hard to distinguish. Since the frequency is changed in 100Hz steps with the IC-701, as opposed to continuous variable frequency systems, tuning is simplified and more accurate.

5-2-2 NB (NOISE BLANKER)

Turn the noise blanker ON (down) when there is pulse type noise, such as ignition noise from automobile motors. Noise will be suppressed and even weak signals will be received comfortably. The noise blanker may not work as effectively when there is a strong signal on a nearby frequency or when there is continuous (not pulse type) noise.

5-2-3 AGC (AUTOMATIC GAIN CONTROL)

The IC-701 has a "hang" AGC system which holds the peak voltage of rectified AF signals from the detector circuit for a certain period. Therefore, during the pauses in normal speech of the received signal, uncomfortable noises will not be heard. The multi-function meter indicates the peak value for a certain period, facilitating reading of the meter "S" function.

For normal SSB reception, set the AGC switch in the UP (slow) position. Set the AGC switch in the FAST (down) position, when tuning or receiving signals with short interval fading. When in the FAST position, the hang AGC circuit is turned OFF and the time constant is shortened. Use the FAST position for RTTY reception.

5-2-4 ATT (ATTENUATOR) SWITCH

Turn the ATT switch ON (down) when strong nearby signals disturb signal reception or make "S" reading difficult. In the ON position a 10dB attenuator is inserted into the receiving antenna circuit, reducing interfering signals and giving more stable reception. In normal operation the ATT switch is left in the OFF (up) position.

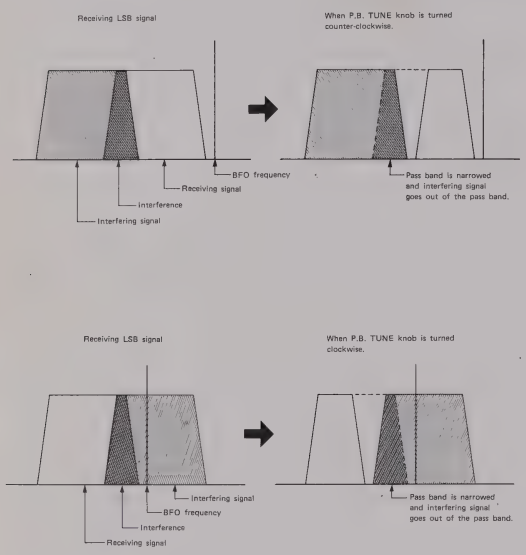
5-2-5 P. B. (PASS BAND) TUNING

Pass Band Tuning is a system in the receive mode to narrow the band width (selectivity) of the frequencies that will pass through the crystal filter electrically from either the upper or lower side continuously by up to 1.5KHz. This is very

effective in reducing interference from nearby signals.

For example, while receiving in the LSB mode, if you get interference from a lower frequency (interfering signals are high pitched tones), narrow the band width by turning the P. B. tuning control counter-clockwise. When the interfering signals are low pitched tones, they are from a higher frequency, and you should narrow the band width by turning the P. B. tuning control clockwise.

When receiving in the USB mode, the band width is narrowed in the opposite manner. Interference from a higher frequency will be high pitched tones, and the P. B. tuning control should be turned clockwise. Interference from a lower frequency will be low pitched tones and the P. B. tuning control is turned counter clockwise.


Receiving LSB signal
When P.B. TUNE knob is turned counter-clockwise.
BFO frequency
Receiving signal
Interference
Interfering signal
Pass band is narrowed and interfering signal goes out of the pass band.
Receiving LSB signal
When P.B. TUNE knob is turned clockwise.
Interfering signal
BFO frequency
Interference
Receiving signal
Pass band is narrowed and interfering signal goes out of the pass band.

This control can also be used for audio tone adjustment, so it may be set for the most comfortable reception. The Pass Band Tune functions only in SSB and RTTY, not in the CW mode.

5 - 2 - 6 TRANSMITTING

Before transmitting, listen in the receive mode to make sure your transmission will not interfer with other communications. If possible, use a dummy load for adjustment instead of an antenna. Set knobs and switches as follows.

MIC GAIN	CENTER
COMP CONTROL	OFF (counter-clockwise til it "clicks")
METER SELECT SWITCH	ALC

Other knobs and switches are left in the same positions as for receiving. When the T/R switch is moved to transmit, or when the PTT (push to talk) switch on the microphone is depressed, the transmit LED is illuminated. By speaking into the microphone, the meter needle will move according to the strength of your voice and SSB signals will be transmitted. Set the MIC Gain control so that the meter needle stays well within the blue ALC zone at voice peaks.

Now set the Meter Select switch to the Ic position. The meter needle should be at about 300mA, with no signals into the microphone. Change to the receive mode by moving the T/R switch to receive, or release the microphone PTT switch.

5 - 2 - 7 HOW TO USE THE SPEECH PROCESSOR

The IC-701 has a low distortion RF Speech Processor built into the set. In equipment having tubes for the final stage, using an RF Speech Processor causes concern about possible tube damage caused by the increase in talk power. However, since the IC-701 is completely solid state, including the finals, and designed for heavy duty use, this worry is eliminated. The RF Speech Processor also enables greater talk power and better results in DX operation.
Follow the steps below for use of the RF Speech Processor:

MIC GAIN CONTROL
TURN FULLY CLOCKWISE
METER SELECT SWITCH
ALC POSITION
COMP CONTROL
TURN FROM THE OFF POSITION UNTIL IT "CLICKS" ON

Switch to transmit and turn the COMP control slowly clockwise while speaking into the microphone until the meter needle moves within the ALC blue zone. (usually about 2/3 clockwise)

Set the meter select switch to the COMP position. Speak into the microphone while transmitting. Turn the MIC gain control down (CCW) so that at the voice peaks, the meter needle is close to "0" on the COMP scale.

Further reduction of the MIC GAIN control to a point where the meter just moves in both COMP and ALC positions yields the best voice quality and maximum peak (not average) power output.

The mic gain and compression levels vary on different bands, so it will sometimes be necessary to repeat the above procedures carefully for the best result.

The COMP control should be turned OFF or MIC carefully set for minimum comp as below for all communications other than DX operation for a very natural voice quality.

5 - 2 - 8 HOW TO USE THE VOX CIRCUIT

The IC-701 has a built-in VOX (voice operated relay) which allows automatic T/R switching by voice signals into the microphone. For VOX use, set the knobs inside the top

access cover as follows:

VOX GAIN CONTROL
FULLY COUNTER-CLOCKWISE
ANTI VOX CONTROL
FULLY COUNTER-CLOCKWISE
VOX DELAY CONTROL
FULLY CLOCKWISE

Turn the VOX switch on the front panel to the ON (down) position. Leaving the T/R switch in the receive position and without pushing the PTT switch, turn the VOX gain control clockwise while speaking into the microphone. At a certain point, the T/R switching circuit will be activated by your voice. This is the proper position for the VOX Gain control. Set the VOX Gain control at a level which provides for T/R switching at your normal voice level. Transmit-release time (the time delay before the set automatically returns to receive when you stop talking) is controlled by the VOX delay control. Turning the control counter-clockwise makes the time shorter. Set it at a position which is comfortable and which allows for short pauses in normal speech.

Adjust the ANTI VOX control so that the VOX circuit is not activated by sounds from the speaker by turning the control clockwise while receiving a signal.

5-3 CW OPERATION

5-3-1 RECEIVING

For CW reception, set the MODE Select Switch to the CW or CW-N position. Other switches and knobs are set the same as for SSB reception. The Pass Band Tune circuit is preset internally for CW reception, therefore, when the MODE Select Switch is set at the CW or CW-N (CW NARROW) position, the Pass Band tuning control on the front panel is inactivated.

In addition to a crystal band pass filter, an audio active filter is built-into this unit. When the MODE Select Switch is set at the CW-N position, this audio filter is activated and the total selectivity of CW reception is improved. Also, with this filter, internal noise is reduced for comfortable CW reception and an improved signal to noise (S/N) ratio.

5-3-2 TRANSMITTING

Insert the keyer plug into the KEY Jack on the rear panel of the unit, and set knobs and switches as follows:

COMP CONTROL OFF (Fully counter-clockwise)
METER SELECT SWITCH Po POSITION
Other knobs and switches are set the same as for CW reception.

By setting the T/R switch to Transmit, the transmit LED is lit and shows that you are ready for CW transmission. When you key the keyer, the meter needle moves and your CW signal is transmitted. To decrease the transmitting power, turn the COMP Control clockwise to ON and rotate to adjust while watching the meter needle on the Po scale for the desired output power.

5-3-3 CW MONITOR

When keying, the side tone oscillator circuit is activated and a 900Hz tone is heard from the speaker. The loudness of this tone is adjusted by rotative the CW MONI Control, located under the access cover. Rotating the CW MONI Control clockwise makes the tone louder. (In the receive mode, this side tone is audible and can therefore be used for Morse Code Practice, adjustment of the keyer, etc.) To receive again, place the T/R switch in the receive position.

5-3-4 SEMI BREAK-IN OPERATION

The IC-701 has Semi Break-In CW capability when using the VOX function. When keying, the unit is automatically set in the transmit mode. After keying, it is returned to the receive mode, also automatically, after a given transmit-release delay time constant. Leave the T/R switch in the Receive position, and set the VOX switch in the ON (down) position.

The transmit release delay time constant is set by adjusting the CW DELAY Control located under the access cover. Turning the CW DELAY Control clockwise will make the transmit release time longer. Set for your keying speed.

5-4 RTTY OPERATION

For RTTY operation, a teletypewriter and a demodulator (terminal unit) which is operational with audio input are necessary. Any demodulator with 2125/2295Hz (narrow, 170Hz shift) or 2125/2975Hz (wide, 850Hz shift) filters can be used with the IC-701. You can select NARROW or WIDE shifts by setting the RTTY SHIFT Switch, located under the Access Cover, to N or W. Fine adjustment of the MARK frequency can be accomplished by rotating the NARROW or WIDE variable resistors, located behind the RTTY SHIFT Switch.

5-4-1 RECEIVING

Audio signals for the demodulator can be supplied from Pin 4 of the ACC socket on the rear panel, or from the PHONES jack on the front panel. The level of the audio signals from Pin 4 of the ACC socket does not vary by turning the AF GAIN Control.

Set the MODE Select Switch to RTTY. The frequencies for NARROW shift are 2295Hz for MARK and 2125Hz for SPACE. For WIDE SHIFT, they are 2975Hz for MARK and 2125Hz for SPACE.

If you have an AFSK generator, set the MODE Select Switch on LSB for RTTY operation. Then the frequencies for NARROW SHIFT are 2295Hz for SPACE and 2125Hz

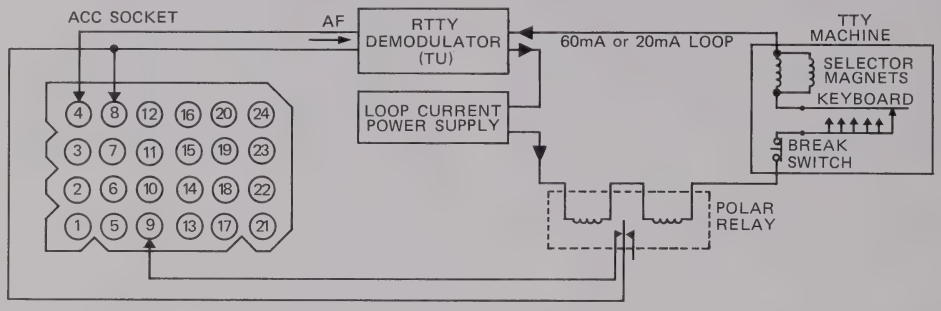
for MARK. For WIDE SHIFT, they are 2975Hz for SPACE and 2125Hz for MARK. Also turn the P. B. Tune control fully clockwise for clear reception.

5 - 4 - 2 TRANSMITTING

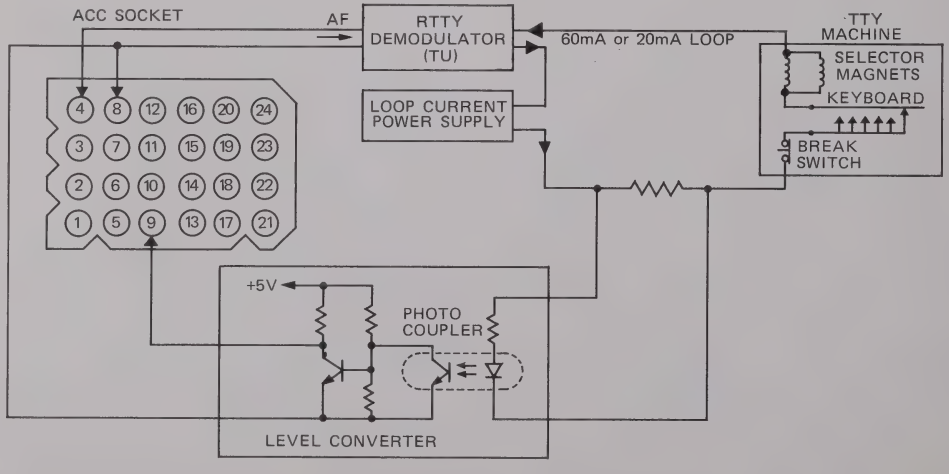
For Keying of the FSK (Frequency Shift Keying) circuit, insert a high speed relay's coil into the loop current circuit of the teletypewriter and connect the relay contacts to Pins 8 and 9 of the ACC socket on the rear panel. The relay contacts make during the SPACE and break during the MARK.

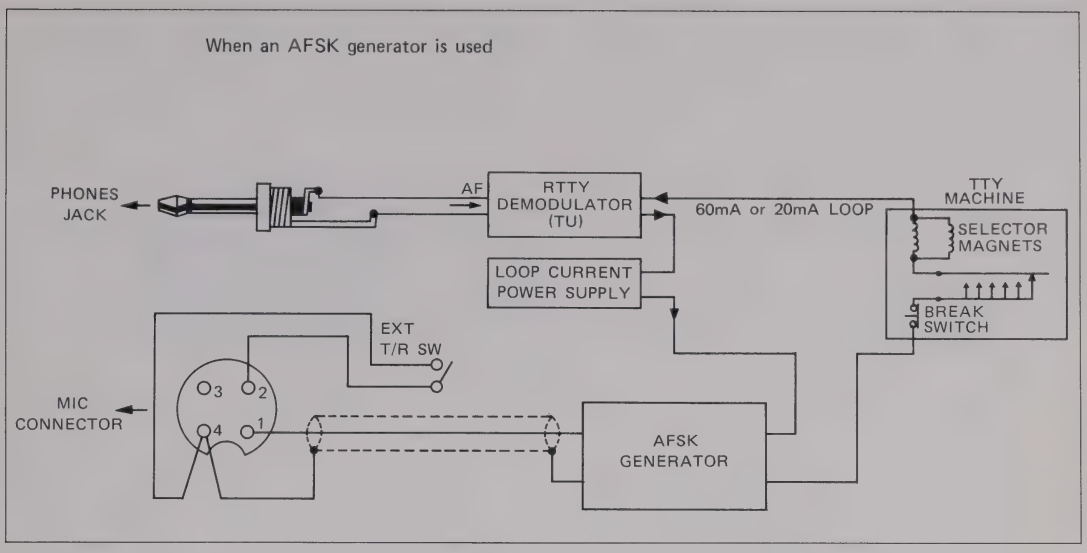
When a level converter for TTL level signals is used, connect the output of the converter to Pins 8 (ground) and 9 of the ACC socket. Apply HIGH level (5V) signals for the MARK and LOW (0V) signals for the SPACE. When using an AFSK generator that has 2125Hz for MARK and 2295Hz (2975Hz in wide shift) for SPACE, connect the output signals for the AFSK generator to the MIC connector on the front panel and turn the MODE Select switch to the LSB mode. In this case, you can use the VOX operation available in the SSB mode, so receive to transmit change over is very easy.

When a high speed relay is used



When a level converter is used





5-5 OTHER OPERATIONS

5-5-1 VSWR READING

The IC-701 has a built-in VSWR meter for checking antenna matching in order to avoid problems caused by VSWR. Set the METER Select switch to the Po position, the T/R switch to Transmit, and Mode switch to the RTTY position. Adjust the SWR SET control so that the meter needle points to "SET" on the meter scale. Set the SWR switch, located under the access cover, to the SWR position. (Before your unit is shipped, the SWR switch is fixed in place in the SET position with a plastic screw. Remove this screw before trying to make VSWR readings). With the switch in the SWR position, SWR reading can be seen on the meter. Although this unit is built to handle VSWR of up to 2:1, it is recommended that the antenna(s) be adjusted for the lowest possible VSWR. After taking the reading, return the switch to the SET position. ALSO BE SURE THAT THE ANTENNA IMPEDANCE IS 52 OHMS OR THERE MAY NOT BE ANY OUTPUT. OTHERWISE THERE WILL BE DAMAGE TO THE TRANSCEIVER.

The final transistors used in the IC-701 are of good design and are protected to a resonable extent by circuits incorporated in the set. These devices can be expected to have an indefinite lifetime since there are no cathodes to burn out. Under some conditions, however, they can be abused beyond tolerance and may have to be replaced.

When in doubt about antenna systems, use the lowest power setting possible to achieve meaningful readings. Use a good tuner or transmatch when necessary. Always use caution and exercise judgement when testing RF power generators.

5-5-2 AUTO DIMMER

For optimum visual comfort, the meter lamp and frequency display LEDs are automatically dimmed and brightened depending on the brightness or darkness of the surrounding light by use of a built-in Dimmer Photosensor, located on the right side of the frequency display on the front panel. For the AUTO DIMMER to function properly, take care that the dimmer photosensor is not covered by your hand or other object.

The threshold for the functioning of the AUTO DIMMER can be adjusted by turning the DIM GAIN Control, located under the access cover. Rotating the control counter-clockwise will lower the operation threshold of the circuit. The circuit can be turned OFF by the DIM switch located also under the access cover.

5-5-3 WWV RECEPTION

To receive WWV (or other standard frequency station), set the BAND SELECT switch to the 14MHz band and the MODE switch to the USB or LSB position. Tune to 15.000.0MHz on the frequency display. The WWV signal can be used for alignment of a frequency counter, marker oscillator, or the frequency display.

5-5-4 SIMPLE FREQUENCY ALIGNMENT

A very accurate frequency counter is necessary to align the frequency of the IC-701. However, the frequency can be aligned simply by receiving the WWV signal.

1. Set the frequency display to 15.000.0MHz and be sure that you are receiving the WWV signal.
2. Set the Mode Select switch to CW. A 900Hz beat can be heard.
3. Short the KEY Jack on the rear panel so that the CW sidetone also becomes audible.
4. Rotate the FREQUENCY SET Control, located under the access cover, so that the two tones are of the same pitch. If the tones are difficult to adjust because of a

difference in their strengths, adjust the CW sidetone level with the CW MONI control, also located under the access cover, until the strengths are the same.

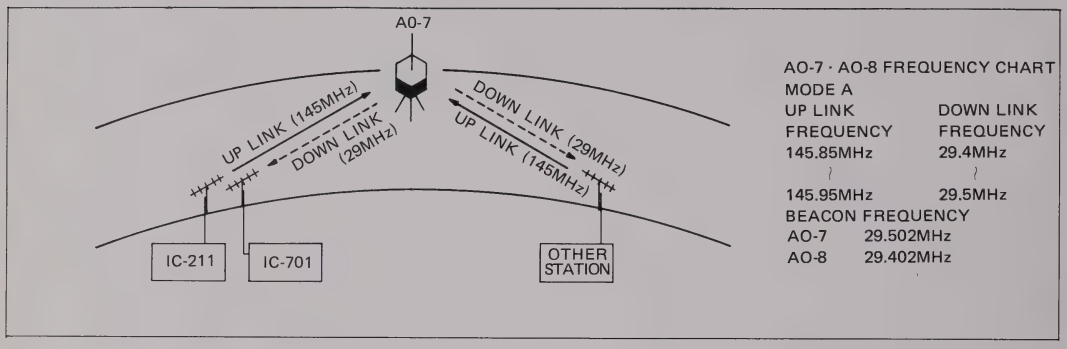
WHEN ALIGNING THE FREQUENCY, DO NOT PUT THE UNIT IN THE TRANSMIT MODE.

Be sure the T/R switch is in the Receive position, the VOX switch is OFF, and that you do not touch the PTT switch on the microphone.

5-5-5 SATELLITE COMMUNICTION

At present there are two active satellites for amatuer radio use, though more are being planned. AMSAT OSCAR 7 was launched in November, 1974, and AMSAT OSCAR 8 was launched in March, 1978. Satellite communications can be made by using an IC-211/211E for transmitting and an IC-701 for receiving. For operation of the IC-211/211E and the IC-701 and for frequency information, refer to the chart below.

Since communication satellites are moving at very high speeds, the down-link signals can be heard on a higher frequency than the real frequency as a satellite approaches, and on a lower frequency as it travels further away. Further information on communicating through satellites can be found in various amateur radio books and periodicals.



AO-7 · AO-8 FREQUENCY CHART

MODE A	
UP LINK FREQUENCY	DOWN LINK FREQUENCY
145.85MHz	29.4MHz
↕	↕
145.95MHz	29.5MHz

BEACON FREQUENCY

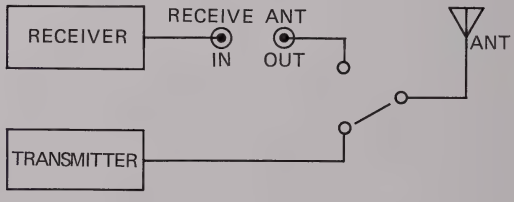
AO-7	29.502MHz
AO-8	29.402MHz

5-5-6 RECEIVE ANTENNA TERMINALS

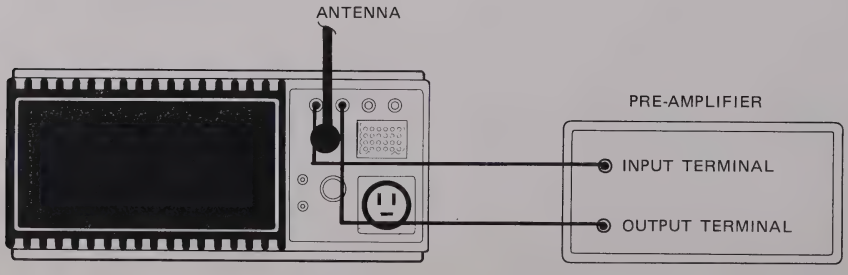
The RECEIVE ANT IN jack is connected to the input terminal of the receiving section, and the RECEIVE ANT OUT jack is connected to the antenna connector through the internal T/R antenna switching circuit. These two jacks are normally jumpered with a cable, but can be used with:

1. A receiving pre-amplifier
2. A separate receiver
3. Separate receiver and transmitter antennas.

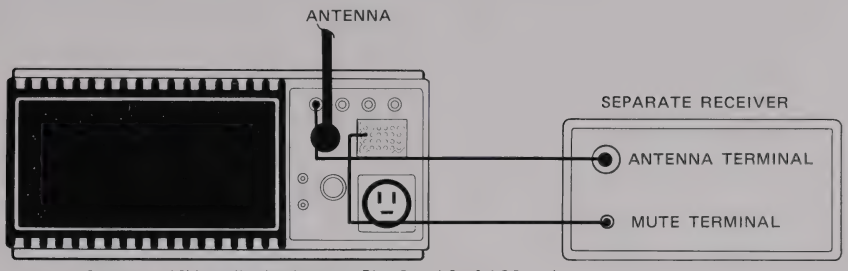
If you wish to use a receiver pre-amplifier, connect it between the receiver input and antenna output terminals. If a separate receiver is used, connect it to the receiver antenna output terminal. For a separate receive antenna, connect it to the receiver input terminal.



CONNECTION OF A PRE-AMPLIFIER

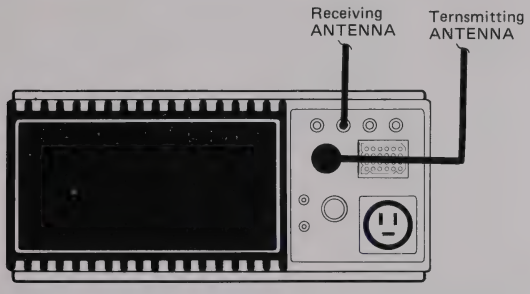


CONNECTION OF A SEPARATE RECEIVER



Connect a 12V small relay between Pins 2 and 3 of ACC socket, and control the separate receiver by contacts of the relay.

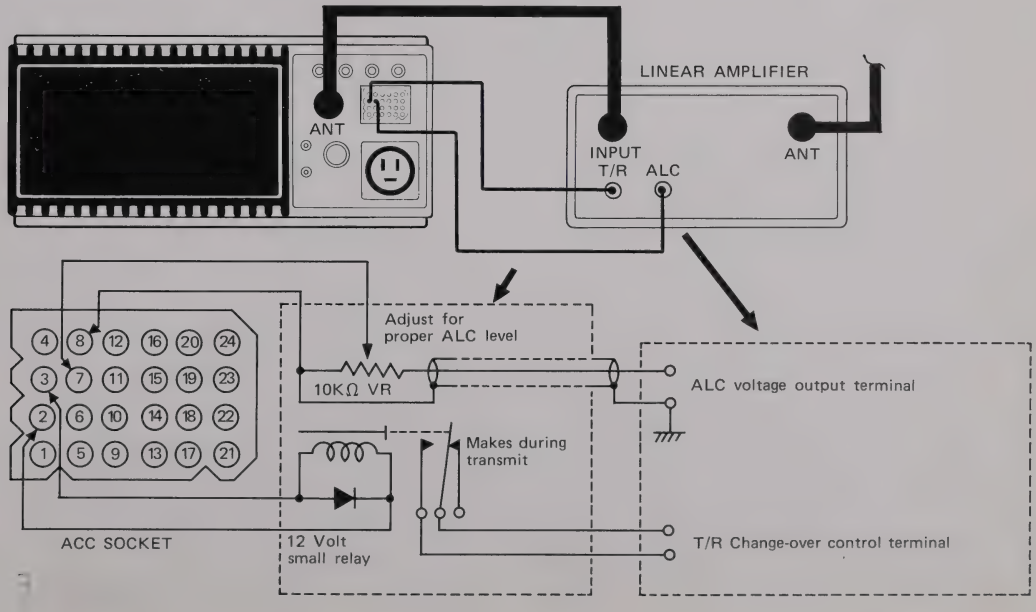
CONNECTION OF SEPARATE ANTENNAS



5-5-7 CONNECTION OF A LINEAR AMPLIFIER

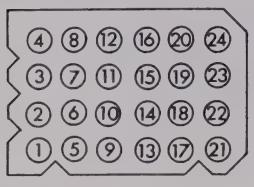
Connect the output connector (ANT) to the input of the linear amplifier. If the linear does not have an RF sense line, it will be necessary to use the circuit shown below to key the Amplifier. If ALC is available from the amplifier, it should be of negative polarity and about 5 volts peak for complete shut down. The ALC voltage should be connected to the ALC connector of the IC-701 and the ALC connector of the amplifier.

CONNECTION OF A LINEAR AMPLIFIER



5-5-8 CONNECTION OF ACCESSORY SOCKET

Various adapters can be used through terminals in this SOCKET for frequency control input, modulation output, receiver output, T/R change-over control and so on. The table below shows terminal connections of this connector. Care should be taken not to apply voltages other than −0.5 V to +5V to terminals between No. 14 and No. 24 as they are connected with the C-MOS IC.



Outside view

ACC SOCKET CONNECTIONS

PIN No.	FUNCTION
1.	NC (no connection)
2.	13.8 Volts DC in conjunction with the power switch operation.
3.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
4.	Output from the receiver detector stage. Fixed output regardless of AF output or AF gain.
5.	Output from Transmitter MIC amplifier stage.
6.	8 Volts DC available when transmitting. (relay can not be directly actuated.)
7.	Input for external ALC voltage.
8.	Ground
9.	Input for RTTY keying (MARK: HIGH level, SPACE: LOW level).
10.	8 Volts DC available when the 28MHz band is selected.
11.	Input for TRANSVERTER control. When 8 Volts DC is applied, set can operate with a transverter.
12.	Output reference voltage for band switching.
13.	INPUT/OUTPUT for external band switching.
14.	CKE Output HIGH level at band edge.
15.	LOCK Input to lock dial externally.
16.	UDC Input to control Up/Down counter externally.
17.	SCAN Input to scan frequency.
18.	CL Input to clear frequency.
19.	FCL Input to clear counter in specified digit and input for MSB data.
20.	K0 Input for frequency control data.
21.	K1 Input for frequency control data.
22.	K2 Input for frequency control data.
23.	K4 Input for frequency control data.
24.	K8 Input for frequency control data.

SECTION 6 THEORY

OUT LINE

The IC-701 employs a digital phase locked loop (PLL) circuit as the local oscillator for both transmit and receive. The output of the PLL circuit is approximately 9MHz above the receive frequency, thereby spurious is kept to a minimum.

The frequency is determined as follows. A pulse generated by the optical chopper circuit, located at the tuning knob, is digitalized by the up/down counter in the LSI (ICOM's custom developed Large Scale Integrated circuit) and used to control a programmable divider, also located inside the LSI chip. The programmable divider controls the PLL circuit which determines the output frequency of the VCO (Voltage Controlled Oscillator).

In the receiver section, signals from the antenna are mixed with the local oscillator output from the PLL circuit. After passing through the pass band tuning circuit, the signals are amplified then detected to become audio signals, amplified again and sent to the speaker.

The transmitter uses a carrier of 9.013MHz for USB and 9.010MHz for LSB. The carrier and the voice signal are sent to a balanced modulator where the DSB suppressed carrier signal is generated. The unwanted sideband is removed by a crystal filter, and an SSB signal of 9.0115MHz is obtained. This SSB signal is mixed with the local oscillator output from the PLL circuit, which is the same as that of the receiver section, and then amplified, filtered, and sent to the antenna.

6-1 RECEIVER

6-1-1 RF AMPLIFIER AND MIXER CIRCUIT

A signal from the antenna is passed through the ALC and filter units and applied to the antenna switching circuit located on unit "B". During reception, Q17, the antenna switching transistor, is ON, thus forward biasing D25 and D26. The incomming signal passes through these diodes, through the external receive antenna jumper, and is fed to the attenuator circuit. If the attenuator switch on the front panel is in the ON position, the signal passes through the attenuator and is attenuated 10dB. The signal is then fed to the RF unit through J3. If the attenuator switch is in the OFF position, the signal is fed directly to J3. D22 through D33 are switching diodes for the input and output signals through their respective RF circuits depending on the band selected. Q15 through Q20 are dual gate MOS FET amplifiers. The incomming signal is fed to the first

gate, and AGC voltage is fed to the second gate to increase the dynamic range of the amplifier. The signal is then passed through a Schottky Diode double balanced mixer composed of D11 through D14 where it is mixed with the local oscillator signal from the VCO. From the mixer, the resultant 9.0115MHz signal passes through a monolythic filter, having a bandwidth of 10KHz, and to the first gate of amplifier, Q3. AGC voltage from pin 6 of J7 is fed to the second gate of Q3 as it is to the gates of Q15 through Q20.

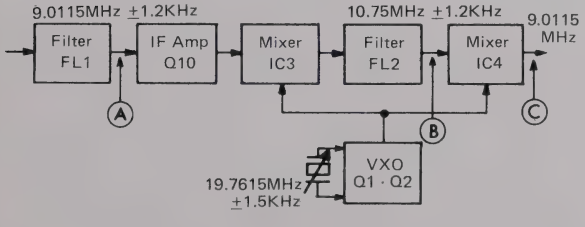
6-1-2 NOISE BLANKER CIRCUIT

The noise blanker circuit is composed of Q8 through Q12. Noise amplified by Q8-Q10 is detected by Q20 and Q21 and applied to the base of Q12. Since the collector of Q12 is connected to the bias circuit of D1 and D2, when Q12 conducts because of detected noise, it shuts off D1 and D2, cutting off the noise. Therefore only clean signals are fed through J1 to the IF circuit.

6-1-3 PASS BAND TUNING CIRCUIT

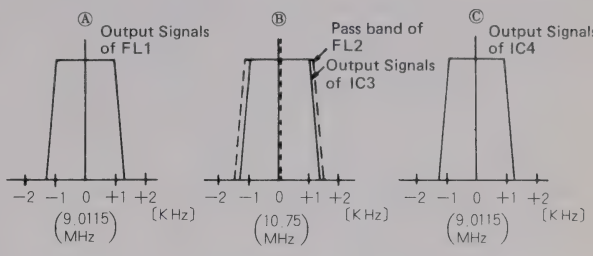
A VXO circuit composed of Q1, Q2, X1 and D4 in the "A" unit. The bias voltage of D4 is changed by turning the Pass Band Tune control, located on the front panel, which varies the VXO frequency (19.7615MHz) by ±1.5KHz. Signals from J1 in the RF unit are fed through J1 in the IF circuit to L5, then through FL1, a crystal filter. FL1's center frequency is 9.0115MHz with a band width of ±1.2KHz. From the filter, the signal is fed to Q10, where it is amplified and fed to the balanced mixer, IC3, where the 9.0115MHz signal is mixed with the 19.7615MHz VXO signal. From the balanced mixer, the resultant 10.750MHz signal is fed through FL2, a crystal filter having a center frequency of 10.750MHz and a band width of ±1.2KHz. This 10.750MHz signal is then again mixed with the VXO frequency, to result in the original 9.0115MHz signal to be fed to the IF amplifier circuit.

The diagrams will explain the operation of the Pass Band Tuning in more detail.



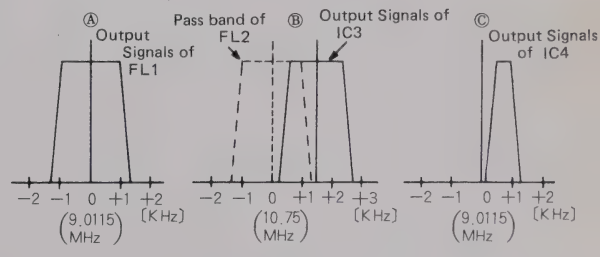
In the diagrams, "A" represents the 10.750MHz signals that are the result of mixing of the 9.0115MHz input signals with the 19.7615MHz VXO signal in IC3. These 10.750 MHz signals are represented by the solid line. The dotted line represents the pass band of the second crystal filter, FL2. With the Pass Band Tune control in the center position, signals between 9.0127MHz and 9.0103MHz (9.0115±1.2KHz), when mixed with the VXO center frequency (19.7615MHz) result in signals of 10.7512MHz to 10.7488MHz (10.750MHz±1.2KHz), all signals will pass through the filter.

A : P.B.TUNE centered


Ⓐ Output Signals of FL1
Ⓑ Pass band of FL2
Output Signals of IC3
Ⓒ Output Signals of IC4
−2 −1 0 +1 +2 [KHz]
(9.0115 MHz)
−2 −1 0 +1 +2 [KHz]
(10.75 MHz)
−2 −1 0 +1 +2 [KHz]
(9.0115 MHz)

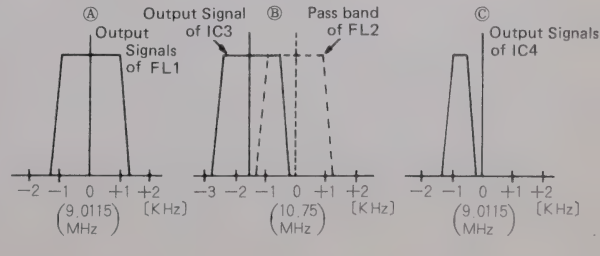
Turning the Pass Band Tune control fully clockwise, the VXO frequency will become 19.7630MHz (19.7615+1.5 KHz). When mixed with the incomming 9.0115MHz signals, the resultant frequencies become 10.7503MHz to 10.7527MHz. Since the upper frequency pass band limit of the filter is 10.7512MHz, not all the signals will be passed by the filter. Only the signals between 10.7503MHz and 10.7512MHz, the upper limit, will be passed. As you can see, the pass band has been narrowed to 900Hz to one side of the center frequency of the filter. Therefore, all signals outside the 10.7503MHz to 10.7512MHz range will not pass through the filter.

B : P.B.TUNE fully clockwise


Ⓐ Output Signals of FL1
Pass band of FL2
Ⓑ Output Signals of IC3
Ⓒ Output Signals of IC4
−2 −1 0 +1 +2 [KHz]
(9.0115 MHz)
−2 −1 0 +1 +2 +3 [KHz]
(10.75 MHz)
−2 −1 0 +1 +2 [KHz]
(9.0115 MHz)

By turning the pass band tuning control in the fully counter-clockwise position, the VXO frequency becomes 19.760MHz. The 10.750MHz signals from the mixer will be from 10.7497MHz to 10.7473MHz. Again with the 10.7512MHz to 10.7448MHz pass band width of the filter, not all signals will be passed. Only those between 10.7497 MHz to 10.7488MHz will be passed. Again, the pass band has been narrowed to 900Hz and offset to the opposite side of the center frequency of the crystal filter.

C : P.B.TUNE fully counter-clockwise


Ⓐ Output Signals of FL1
Ⓑ Output Signal of IC3
Pass band of FL2
Ⓒ Output Signals of IC4
−2 −1 0 +1 +2 [KHz]
(9.0115 MHz)
−3 −2 −1 0 +1 +2 [KHz]
(10.75 MHz)
−2 −1 0 +1 +2 [KHz]
(9.0115 MHz)

This action, and what this circuit really can do for you is better explained with an example.

If you are receiving a signal, whose frequency at the input of the mixer is 9.0115MHz and another signal whose frequency is 9.0125MHz is present, after being mixed with the 19.7615MHz VXO frequency (center frequency) the resultant frequencies are 10.750MHz, the signal you are listening to, and 10.7490MHz, the other signal. Both are within the pass band of the filter, and therefore, both will be heard. However, by turning the pass band tune control until the VXO frequency reaches 19.7605MHz, the 9.0125 MHz interfering signal when mixed with the VXO frequency will have a resultant frequency of 10.7480MHz, which is out of the pass band of the filter. The signal you are listening to, however, when mixed with the VXO frequency becomes 10.749MHz. This is within the pass band of the filter, and when mixed again with the VXO frequency in the next stage, becomes it's original 9.0115MHz signal and is sent to the IF amplifier. You have pushed the interfering signal out of the pass band of the filter, and therefore eliminated it and the interference it caused.

In the CW mode (CW or CW-N position of the MODE switch), a fixed bias voltage is applied to D4 of the VXO circuit, so the VXO frequency shifts to 19.7634MHz (+1.9KHz). The bandwidth then becomes ±250Hz for clear CW reception.

The signal which has passed through the pass band tuning circuits are amplified by Q11 and Q12, dual gate MOS FET's. AGC voltage is applied to the second gate of both. The amplified IF signal is then sent to the detector circuit.

6-1-4 DETECTOR CIRCUIT

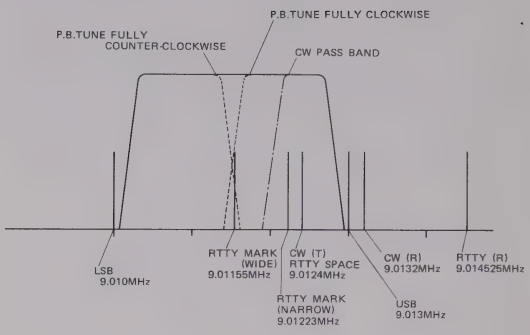
The detector circuit is composed of IC2, a differential amplifier that consists of a pair of similar input circuits and a constant-current source. The IF signals are fed to the both input circuits of IC2 180 degrees out of phase, and the BFO signal is fed to the constant-current source. The detected audio signal is sent to the CW AF filter circuit and the AF amplifier circuits through the MODE switch.

6-1-5 BFO CIRCUIT

The BFO circuit is composed of Q18 to Q20 and crystals X1 and X2, all located on the "B" unit. Q19 is the crystal oscillator, Q18 is the buffer, and Q20 is the FSK (Frequency Shift Keying) keyer for RTTY.

The crystals are switched by D12 and D13, and the oscillation frequencies are shifted by D14 to D18, according to the mode used. Crystal X1 (9.013MHz) is used for USB transmitting and receiving, CW receiving, and RTTY receiving. Crystal X2 (9.010MHz) is used for LSB transmitting and receiving, CW transmitting, and RTTY transmitting. In the RTTY transmitting mode, the bias voltage to D19 (a varicap) is changed according to the MARK and SPACE RTTY signals, by Q20. S3 (RTTY shift switch) changes the shift width for Narrow (170Hz) shift, and Wide (850Hz) shift.

BFO FREQUENCY CHART



	MODE	FREQUENCY
RECEIVE	LSB	9.010 MHz
	USB	9.013 MHz
	CW	9.0132 MHz
	RTTY	9.014525MHz
TRANSMIT	LSB	9.010 MHz
	USB	9.013 MHz
	CW	9.0124 MHz
	RTTY	9.0124 MHz (SPACE)
		9.01223 MHz (170MARK)
		9.01155 MHz (850MARK)

6-1-6 CW AF FILTER CIRCUIT

After detection, the audio signal is applied to IC6. Next, the signal is fed to a CW AF filter composed of high and low pass filters. The filters have a pass band of about 800Hz ±100Hz. If the mode switch on the front panel is turned to CW-N, the signal passes through this band pass filter and goes to the audio amplifying section in the next stage. During other modes, the detected output is directly applied to the audio amplifier circuit.

6-1-7 AUDIO AMPLIFIER CIRCUIT

The audio amplifier circuit is composed of Q44 to Q46. The amplified signal passes through an AF gain control on the front panel, and then goes into Q27, an audio low pass filter, where signal components above 3KHz are removed. After that, the signal is amplified in the audio power amplifier circuit, IC1, which then drives the speaker.

6-1-8 AGC CIRCUIT

The AGC circuit is composed of Q28 to Q36 on the "A" unit. After detection, for CW-N after passing through the CW AF filter, the AF signal is amplified by Q28. It then undergoes peak hold detection by detector Q32. The detected DC voltage charges C101 and C102. The DC voltage is then amplified further by Q33 and Q34. Thus, the AGC voltage for RF and IF amplifier circuits is

obtained from the collector of Q34.

When the AGC switch is in the SLOW position, the output signal of Q28 is fed to another peak hold detector, Q29. The detected DC voltage charges C99 and switches Q30 ON and Q31 OFF. When the input signal is removed, the charged voltage of C99 is discharged through R159 and Q31 is switched ON, and the charged voltage in C101 and C102 is discharged through R164 and Q31. Thus the AGC voltage is held during the time constant of C99 and R159.

When the AGC switch is in the FAST position, –9 Volts is applied to the base of Q30, turning it OFF, and turning Q31 ON. Therefore the AGC voltage does not hold, and the AGC release time is determined by C101 and R192. The AGC attack time varies with the mode of operation, so when the mode is changed, so are the determining fixed resisitors. C101 and C102 are the capacitors that are in the circuit for all modes, and determine the time constant along with the following resistors: For USB and LSB, R166 and R192 (in paralell), both of which are located on the "A" unit. For CW and RTTY, R192 and R48, which are located on the mode switch (in series); As the time constant circuit may be charged during transmit, Q35 is designed to be ON during transmit time, through D33, and shunts C101 and C102. When the power is turned ON, a pulse through R173 and C103 turns ON Q35 temporarily to discharge C101 and C102 in order to allow the AGC voltage to recover to a non-signal bias state.

Q36 superimposes the RF Gain control voltage on the AGC line by way of the emitter follower, forming a threshold-type RF gain control. As the RF AGC circuit operates as the ALC circuit during transmit, Q36 is biased through D31 to remove interference troubles.

6 - 2 TRANSMITTER

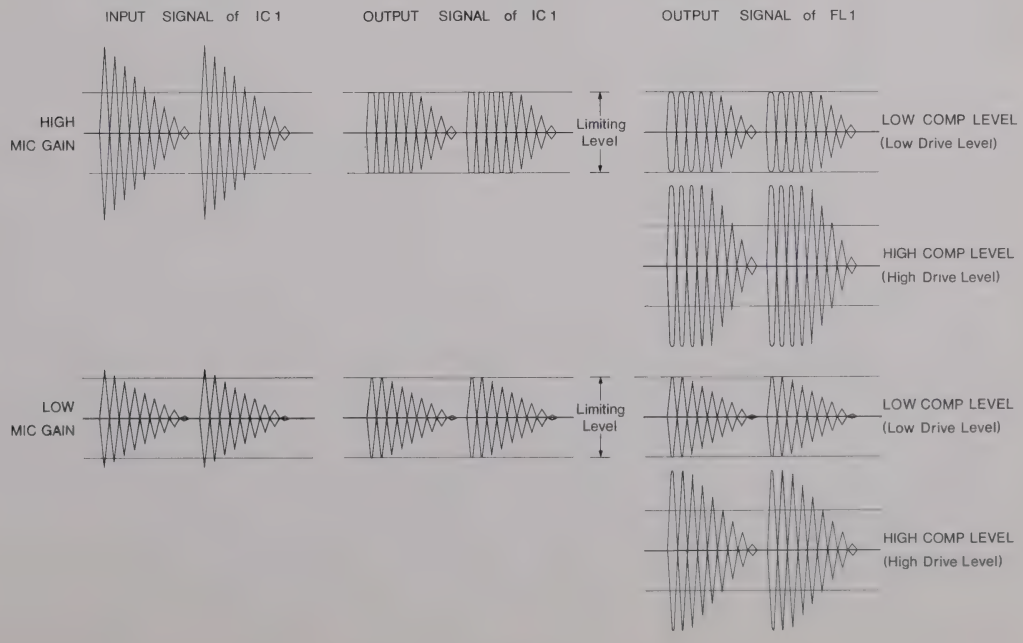
6 - 2 - 1 MICROPHONE AMPLIFIER CIRCUIT

Voice signals from the microphone are passed through the MIC Gain control on the front panel and applied to Q17, the ALC attenuator, located on "A" unit. The ALC voltage is applied to the gate of Q17, which changes the source-to-drain impedance. Accordingly, the ALC controls the voice signal passing through Q17. The signal is then fed to amplifiers Q15 and Q16 and then sent to the balanced modulator.

6 - 2 - 2 BALANCED MODULATOR CIRCUIT

IC5 is a balanced modulator where the BFO signal, fed through Pin 10, and the voice signal, fed through Pin 4, result in a double side band signal output from Pins 6 and 12. When the mode switch is in the CW, CW-N or RTTY mode, power for the MIC AMP circuit is turned OFF and therefore, the voice signal is not applied to IC5. Instead, a voltage from D23 is applied to Pin 4, IC5 loses balance, and the BFO signal becomes the output. This signal is used for the carrier in CW and RTTY operation. During RTTY operation, the frequency is shifted according to the keying in the BFO. During CW operation, a key is connected to the base of Q14. The key turns Q14 ON and OFF at the keying rate, therefore, turning OFF D22 and the carrier, ON and OFF at the keying rate.

When the speech processor circuit is not used, the output signal of IC5 (DSB signal) is fed to the crystal filter FL1 through D21, D22 and D34. FL1 cuts the unwanted side band of the DSB signal and the output is a Single Side Band signal. (CW and RTTY signals pass through FL1 as unchanged wave forms). From the filter, the signal is sent to the RF unit through P1.


INPUT SIGNAL of IC 1
OUTPUT SIGNAL of IC 1
OUTPUT SIGNAL of FL1
HIGH MIC GAIN
LOW MIC GAIN
Limiting Level
Limiting Level
LOW COMP LEVEL (Low Drive Level)
HIGH COMP LEVEL (High Drive Level)
LOW COMP LEVEL (Low Drive Level)
HIGH COMP LEVEL (High Drive Level)

When the speech processor circuit is used, the output signal of IC5 is fed to the speech processor circuit through D22 and D13.

6 - 1 - 3 SPEECH PROCESSOR CIRCUIT

The speech processor circuit uses the pass band tuning circuit. While transmitting with the processor ON, a DSB signal output in the balanced modulator is passed through D22 and D13, and applied to IC3, where it is mixed with the VXO output frequency of 19.7615MHz. It passes through the crystal filter FL2 and becomes an SSB signal of 10.750MHz. This signal is mixed with the VXO output at IC4 again to become an SSB signal of 9.0115MHz, amplified by Q11, and passed to IC1. Q11 as well as Q12 and D19 are in the compressor level detection circuit, and the output for the compressor level indicator is obtained from the source of Q11. IC1 is the limiting circuit, and it clips signals above a fixed level, as shown in the figure on page 23.

Q4 is the drive level control circuit. By turning the COMP (compressor) control, the bias voltage is changed and gain is controlled. Some splatter is included in the signal which has passed through the limiter circuit, but this is completely removed by the crystal filter FL1, and the final signal is a clean and powerful SSB signal.

In the CW and RTTY modes, the speech processor circuit works the same as in the SSB mode, and the output power is adjustable from 0 to about 100 Watts by turning the COMP control knob.

6 - 2 - 4 TRANSMIT MIXER CIRCUIT

The output from P1 of the "A" unit is passed to J1 on the RF unit, and after passing through the T/R switching diode, D4, it is applied to Q1, the attenuator of the drive level control for each band. Each band has its own drive level control in the RF amplifier circuit. In order to conpensate for this, the voltage fixed at R92 to R97 is applied to the gate of Q1, and proper drive for each band is obtained.

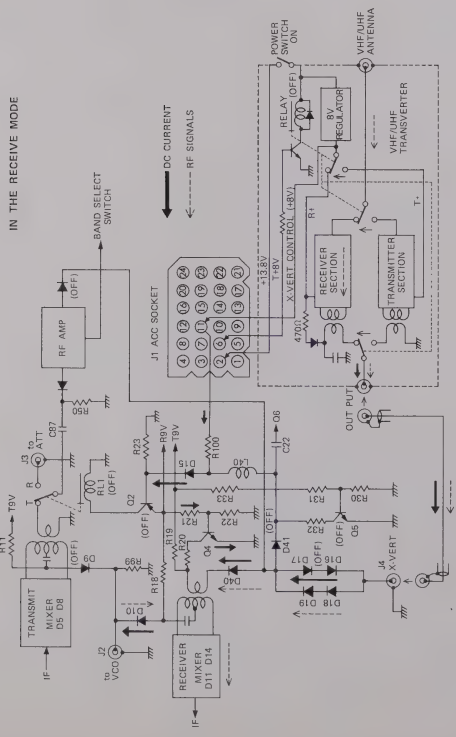
The output is mixed with the VCO output frequency in the Schottky diode double balanced mixer circuit composed of D5 to D8, and the output becomes the final transmitting frequency. The mixed output is fed to RF amplifier through the T/R relay RL1.

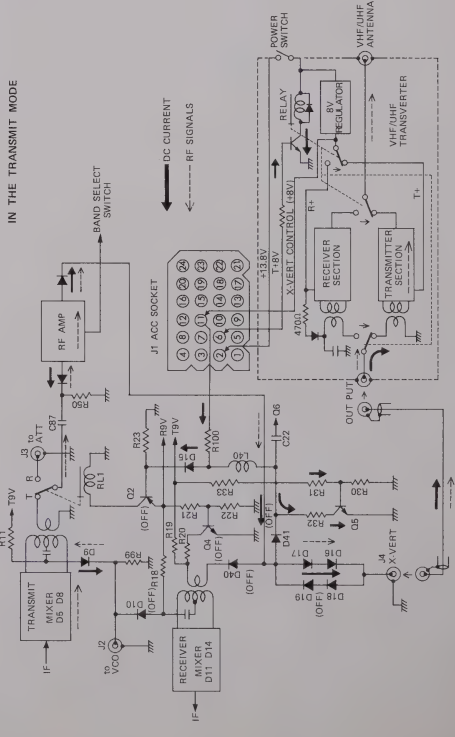
6 - 2 - 5 RF AMPLIFIER CIRCUIT

The mixed output is applied to the RF amplifier circuit (the same one as is used in the receiver section) composed of Q15 to Q20 which are set for each band. L20 to L25 and L26 to L31 are multiple coupled resonant coils which are staggered to obtain a flat wide band pass. The output is fed through T/R switch diode D41, and is amplified by Q9, the predrive circuit in the next stage, to a level of about 50 milliwatts. This is then fed to J6.

6 - 2 - 6 TRANSVERTER OUTPUT CIRCUIT

When a transverter is used for VHF or UHF operation, connect the input/output cable from the transverter to J4, X-verter Jack on the rear panel. Also apply +8 Volts DC to pin 11 of J1 (ACC socket) on the rear panel.





ICOM

DESK MICROPHONE IC-SM2

取扱説明書

この度はデスクマイクロホンIC-SM2をお買上げいただき、ありがとうございました。

このマイクロホンはエレクトレット　コンデンサー　タイプであり、プリアンプも内蔵していますので、クリアーな音質と余裕ある感度が得られ、固定局用として最適のマイクロホンと確信いたします。

このマイクロホンはエレクトレット　コンデンサー　タイプであり、プリアンプも内蔵していますので、直流電圧を加えなければ動作しません。直流電圧はマイクロホンの低周波出力端子に重畳して加えるようになっています。

弊社の４Ｐマイクコネクター付のトランシーバーは、そのまま使用できるように配線されています。

その他のトランシーバー（送信機）に使用されるときは右図のようにトランシーバー（送信機）を改造してください。

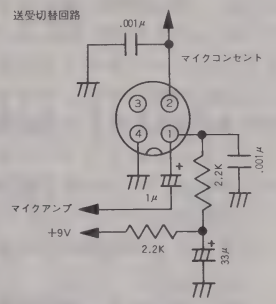


図１

定　　格

形　　式	エレクトレット コンデンサー タイプ
指　向　性	単一指向性
出力インピーダンス	120Ω　±30% at 1000Hz （抵抗器最大にて）
感　　度	−56dB　±5dB　at 1000Hz 0dB＝1V/μber(低抗器最大にて)
周波数帯域	150Hz～8000Hz　図２ワク内
重　　量	285g(コード､コネクターを含む)
内部回路	図１のとおり

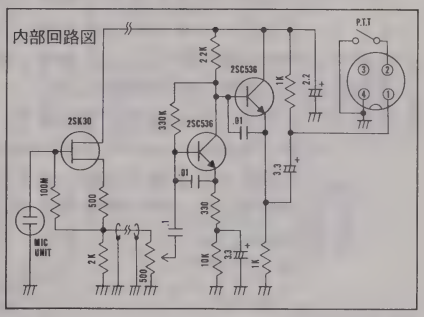
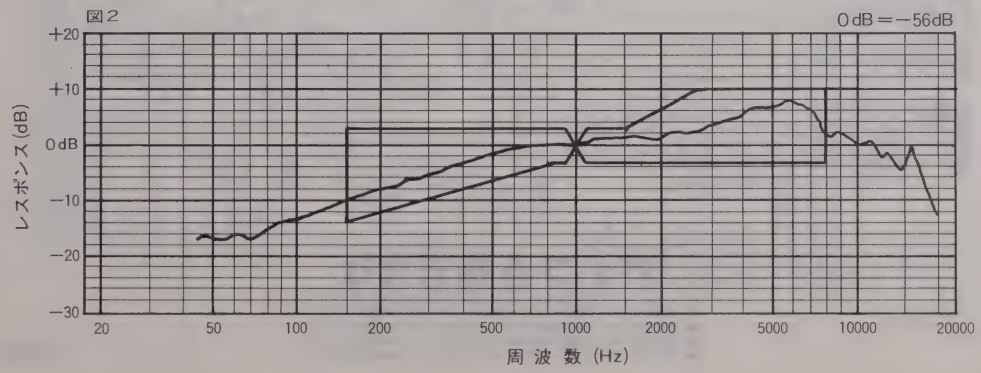


図２



使いかた

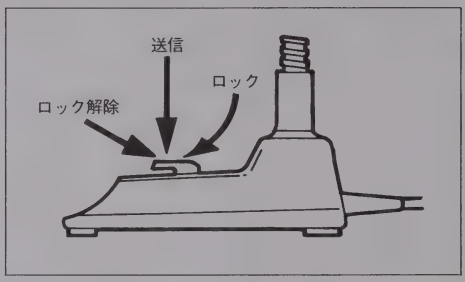
1.マイクロホンのプラグをトランシーバー（送信機）のマイクコンセントに接続してください。

2.右図のようにP.T.T.スイッチを下方に押しますと送信状態になりますので、P.T.T.スイッチを押しながらマイクロホンに向って話してください。
P.T.T.スイッチから手をはなしますとスイッチが切れ、受信状態に戻ります。

3.P.T.T.スイッチを下方へ押しながら手前に引きますとスイッチがロックされ、手をはなしても送信状態のままになりますので、長時間続けて送信するとき等は大変便利です。ロックされたP.T.T.スイッチを受信状態に戻すときは、スイッチを前方に押し、手をはなします。

4.口とマイクロホンの距離は30cm位が適当です。
マイクロホン台の裏面に感度調整用の半固定抵抗器があり、H側に回わしますと感度が上がり、L側に回わしますと感度が下がります。（口とマイクロホンの距離、声の大きさ、周囲の状況等によって適当な感度となるように調整してください）

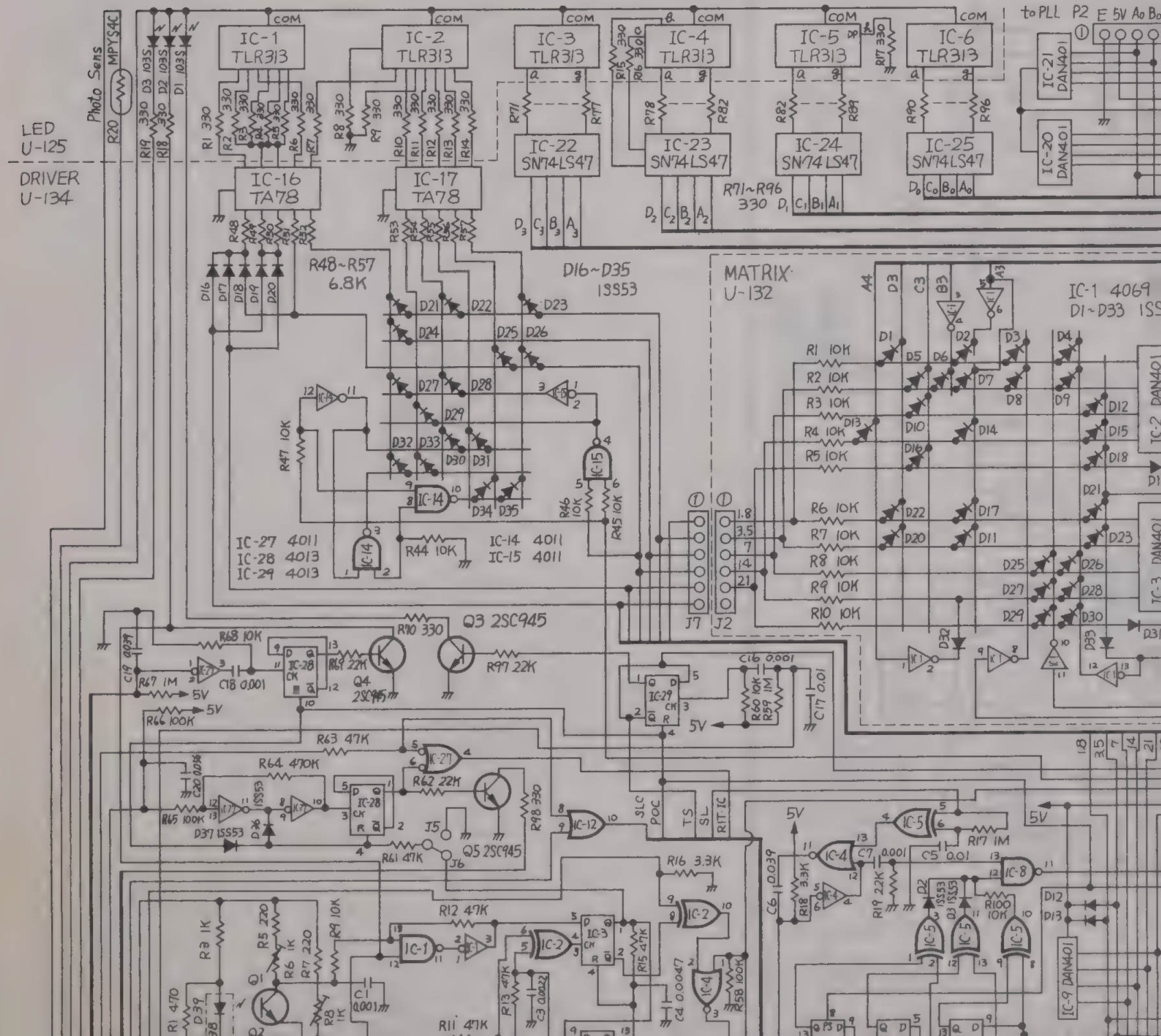
5.ウインドスクリーンが付属しています。風による雑音、湿気等によってマイクロホンユニットを痛めるのを防ぐため、できるだけマイクロホンユニットに取り付けるようにしてください。



アイコム株式会社

■本　　社　〒547 大阪市平野区加美駅作1丁目6番19号　☎(06)793—5301(代)
■大阪営業所　〒547 大阪市平野区加美南1丁目8番35号　☎(06)793—0331(代)
■東京営業所　〒161 東京都新宿区中井2丁目1番28号 大木ビル3F　☎(03)954—0331(代)
■名古屋営業所　〒456 名古屋市熱田区森後町1丁目60番地宝ビル1F　☎(052)682—8151(代)
■九州営業所　〒812 福岡市博多区下臼服司4番28号　☎(092)281—1296(代)

IC-701 SCHEMATIC DIAGRA



使 い か た

1.マイクロホンのプラグをトランシーバー（送信機）のマイクコンセントに接続してください。

2.右図のようにP.T.T.スイッチを下方に押しますと送信状態になりますので、P.T.T.スイッチを押しながらマイクロホンに向って話してください。
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マイクロホン台の裏面に感度調整用の半固定抵抗器があり、H側に回わしますと感度が上がり、L側に回わしますと感度が下がります。（口とマイクロホンの距離、声の大きさ、周囲の状況等によって適当な感度となるように調整してください）

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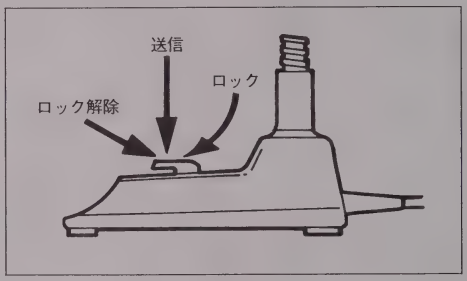

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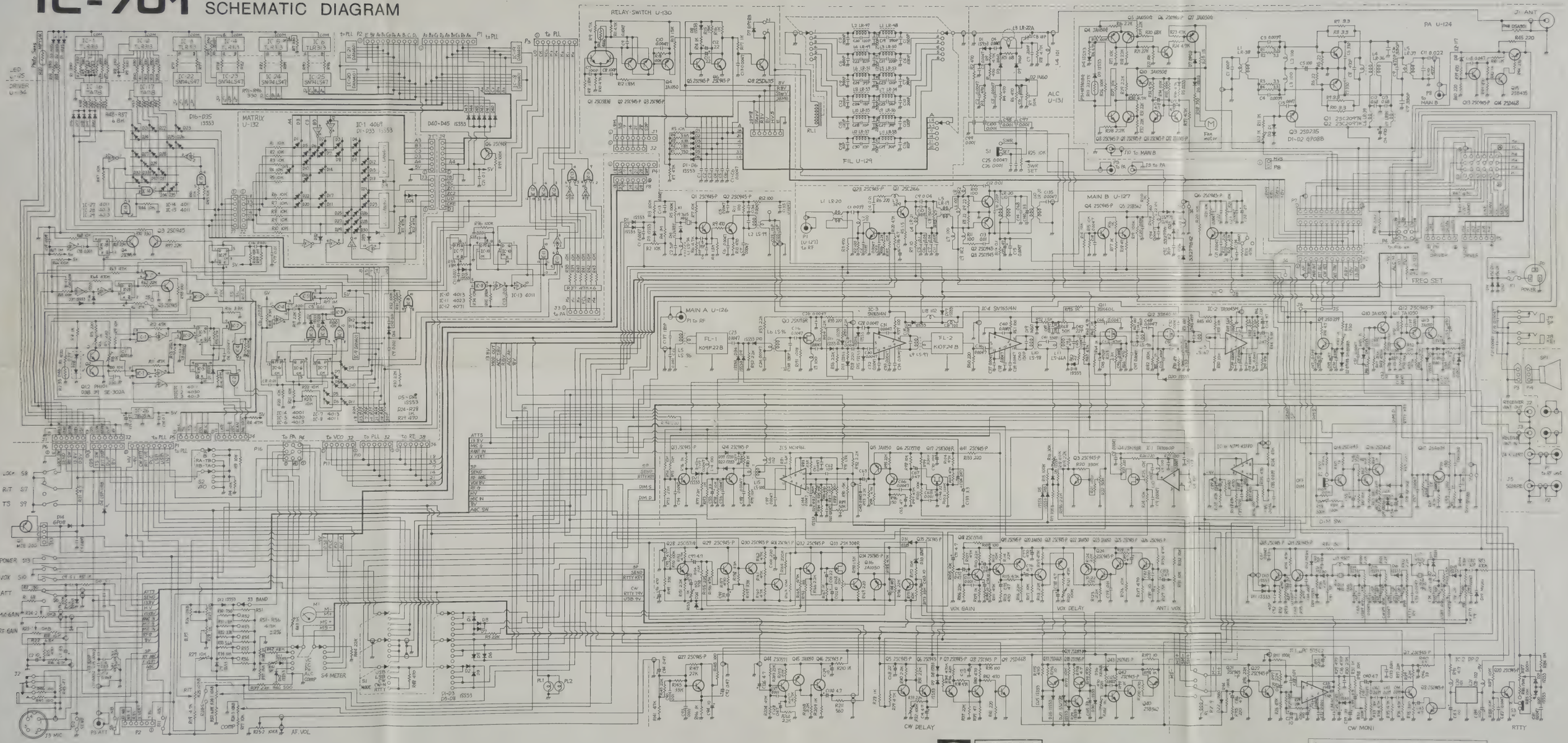
■九州営業所　〒812 福岡市博多区下呉服町4番28号　☎(092)281-1296(代)

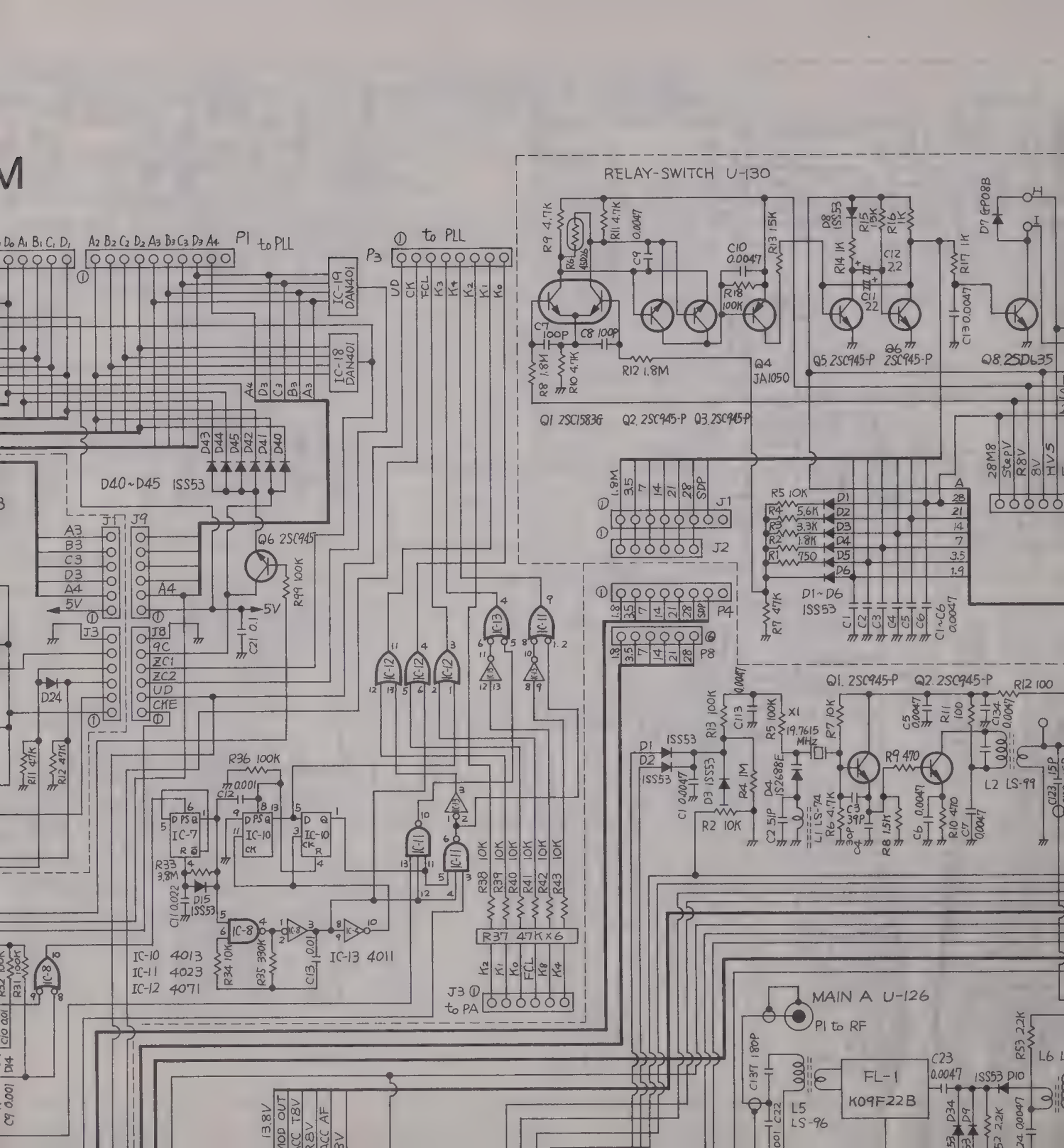
IC-701 SCHEMATIC DIAGRAM

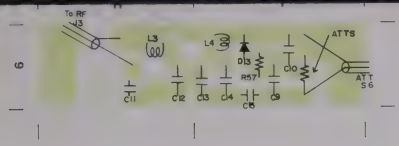


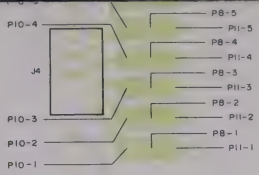
ICOM ICOM INCORPORATED

Some components subject to change for an improvement without notice.

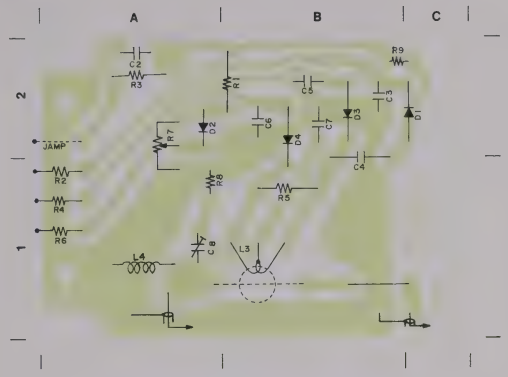
A-0152

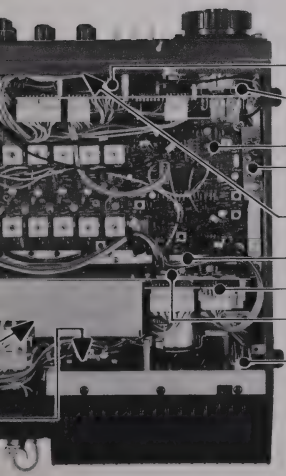

RELAY-SWITCH U-130
MAIN A U-126
P1 to PLL
P3
to PLL
D40~D45 ISS53
Q6 2SC945
Q1 2SC1583G
Q2. 2SC945-P
Q3. 2SC945-P
Q4 JA1050
Q5. 2SC945-P
Q6 2SC945-P
Q8. 2SD635
D7 6P08B
IC-19 DAN401
IC-18 DAN401
J1
J2
J3
J8
J9
P4
P8
IC-10 4013
IC-11 4023
IC-12 4071
IC-13 4011
J3 to PA
P1 to RF
FL-1 K09F22B
L5 LS-96
L2 LS-99
X1 19.7615 MHz
Q1. 2SC945-P
Q2. 2SC945-P





ALC UNIT





ICOM

BOARD LAYOUT

HF ALL BAND TRANSCEIVER

IC-701

Some components subject to change for an improvement without notice.

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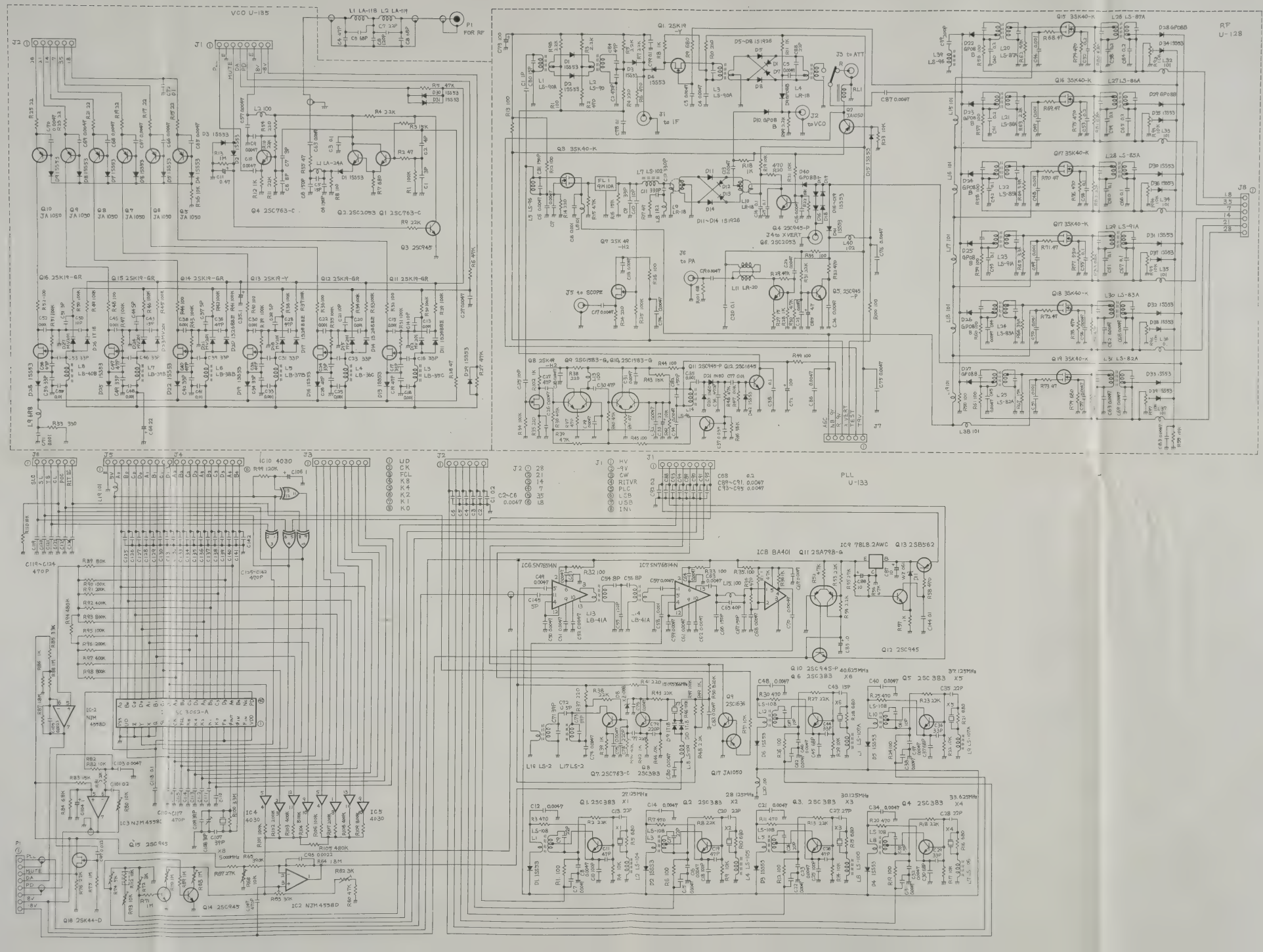
VCO U-135
RF U-128
PLL U-133
Q1 2SK19-Y
Q2 2SC1053 Q1 2SC763-C
Q3 2SC945
Q4 2SC763-C
Q5 2SC945-P
Q6 2SC1053
Q7 2SK49-H2
Q8 2SK49-H2
Q9 2SC1583-Q, Q10 2SC1583-Q
Q11 2SC945-P Q12 2SC1845
Q13 2SB562
Q14 2SC945
Q15 2SC945
Q16 2SK19-GR
Q17 JA1050
Q18 2SK44-D
IC1 NJM4558D
IC2 NJM4558D
IC3 NJM4558D
IC4 4030
IC5 4030
IC6 SN76514N
IC7 SN76514N
IC8 BA401
IC9 7818.2AWC
IC10 4030
IC11 SC623-A
Q15 3SK40-K
Q16 3SK40-K
Q17 3SK40-K
Q18 3SK40-K
Q19 3SK40-K
D1~D4 1S1553
D5~D8 1S1926
D10 6P08 B
D11~D14 1S1926
L1 LA-11B L2 LA-11A
L2 LA-34A
L3 LS-10A
L4 LR-18
L5 LS-9B
L7 LS-10B
L8 LR-18
L9 LR-18
L10 LR-18
L11 LR-20
L12 LB-40B
L13 LB-41A
L14 LB-41A
L15 LB-37B
L16 LS-2
L17 LS-2
L18 LB-36C
L19 LB-37C
L20 LS-87A
L21 LS-88A
L22 LS-89A
L23 LS-90A
L24 LS-91A
L25 LS-82A
L26 LS-87A
L27 LS-86A
L28 LS-85A
L29 LS-91A
L30 LS-83A
L31 LS-82A
L32 LS-89A
L33 LS-90A
L34 LS-91A
L35 LS-83A
L36 LS-82A
L37 LS-107A
L38 101
L39 LS-96
L40 LS-96
X1 27.125MHz
X2 28.125MHz
X3 30.125MHz
X4 33.625MHz
X5 37.125MHz
X6 40.625MHz
X7 5.000MHz
X8 5.000MHz
P1 FOR RF
J1 to IF
J2 to VCO
J3 to ATT
J5 to SCOPE
J6 to PA
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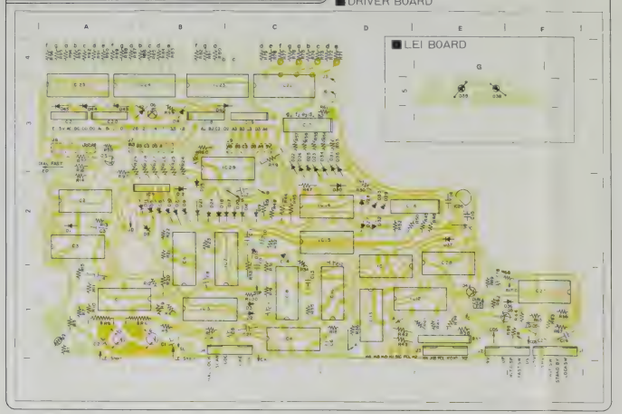
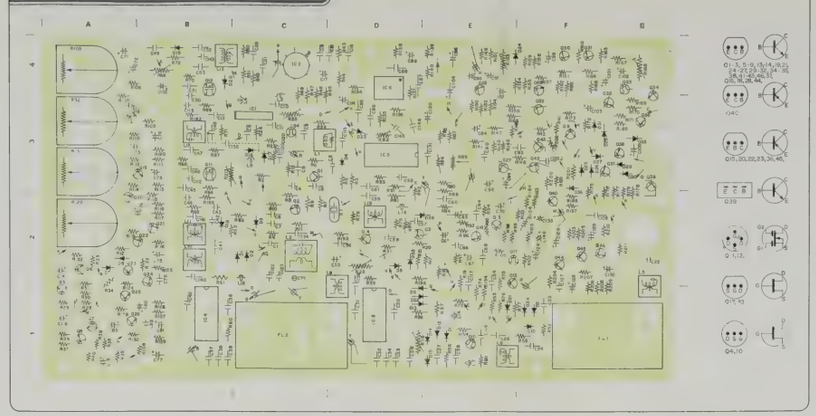
DRIVER UNIT

■DRIVER BOARD

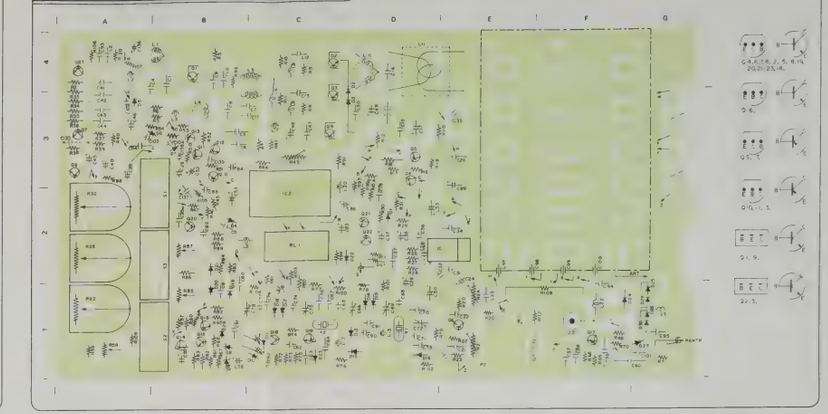
■LEI BOARD



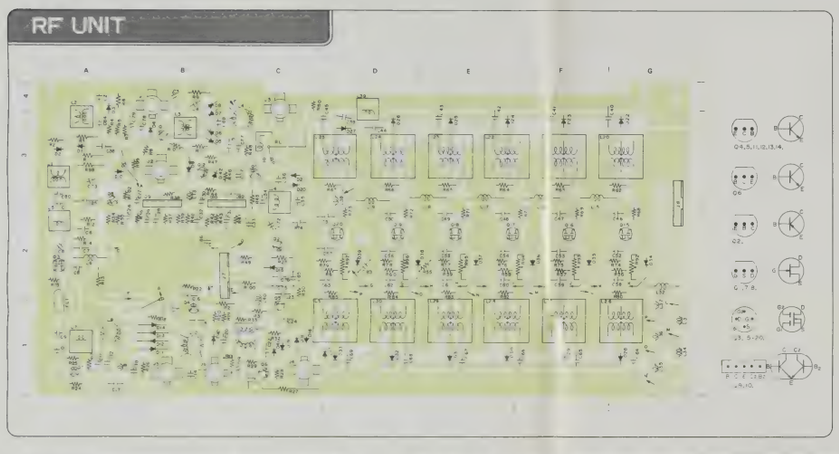
A UNIT



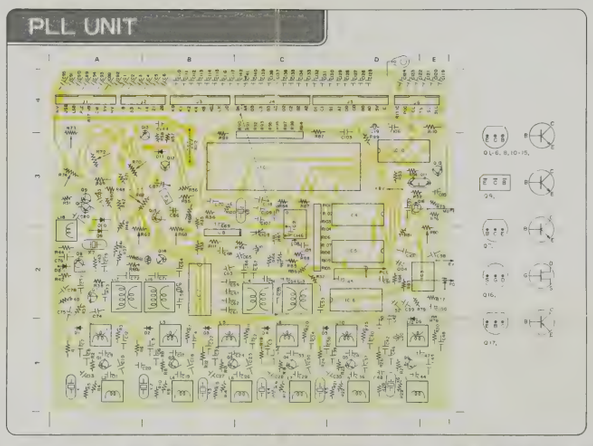
B UNIT



RF UNIT



PLL UNIT



EF UNIT

■BAND SWITCH BOARD

■WIRING BOARD

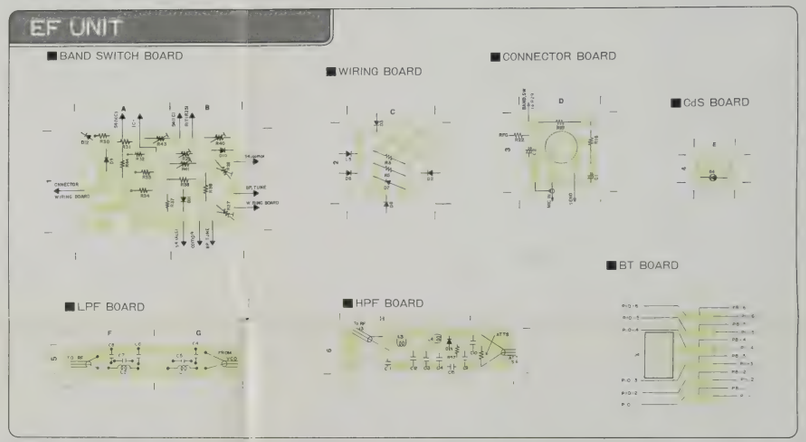
■CONNECTOR BOARD

■CdS BOARD

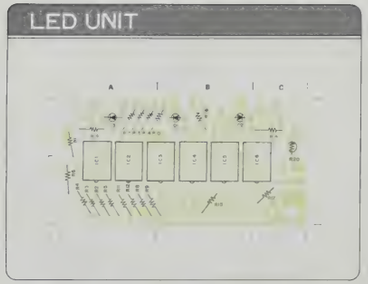
■BT BOARD

■LPF BOARD

■HPF BOARD



LED UNIT



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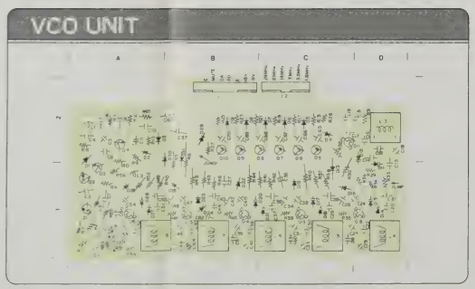

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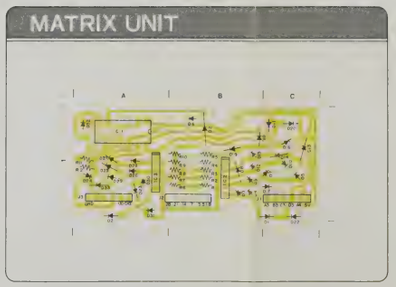

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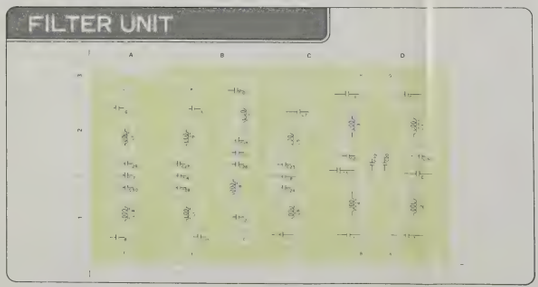
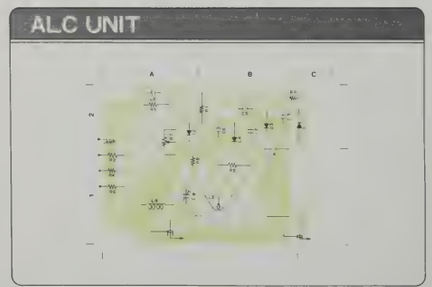
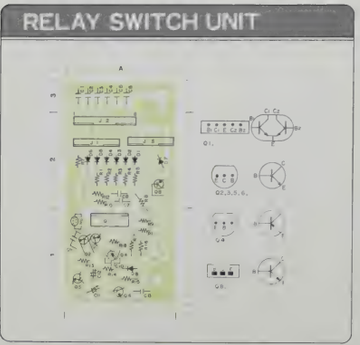


ALC UNIT



RELAY SWITCH UNIT

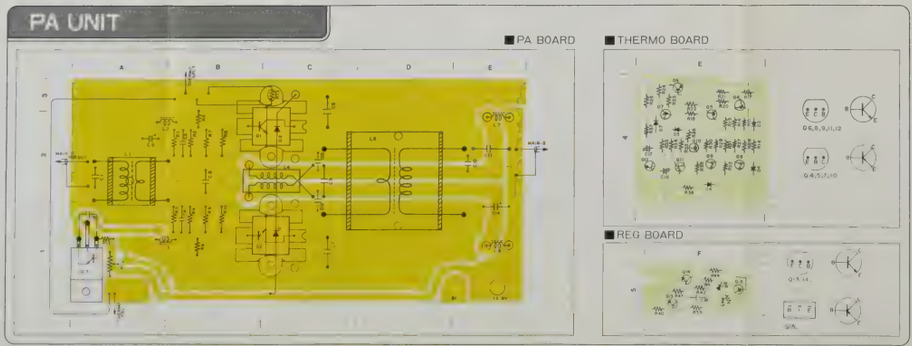


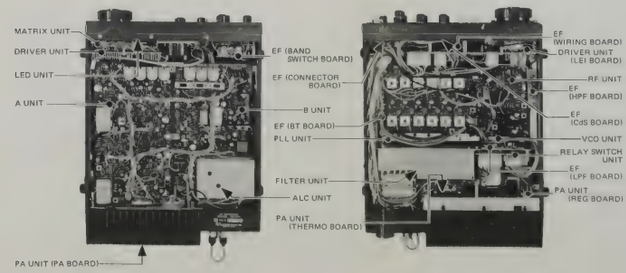
PA UNIT

■PA BOARD

■THERMO BOARD

■REG BOARD





ICOM

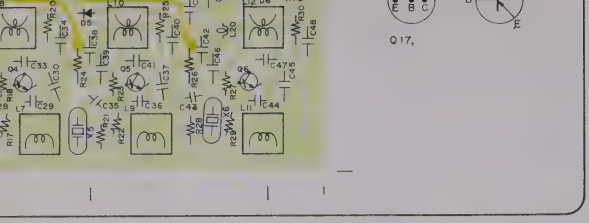
BOARD LAYOUT

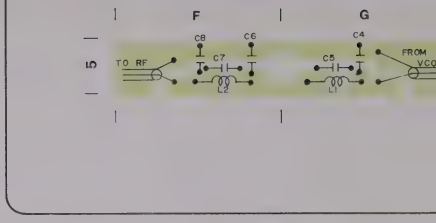
HF ALL BAND TRANSCEIVER

IC-701

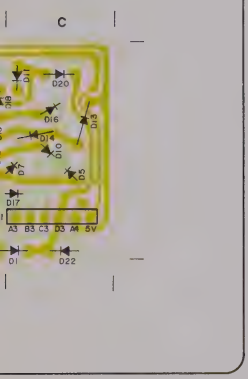
Some components subject to change for an improvement without notice.

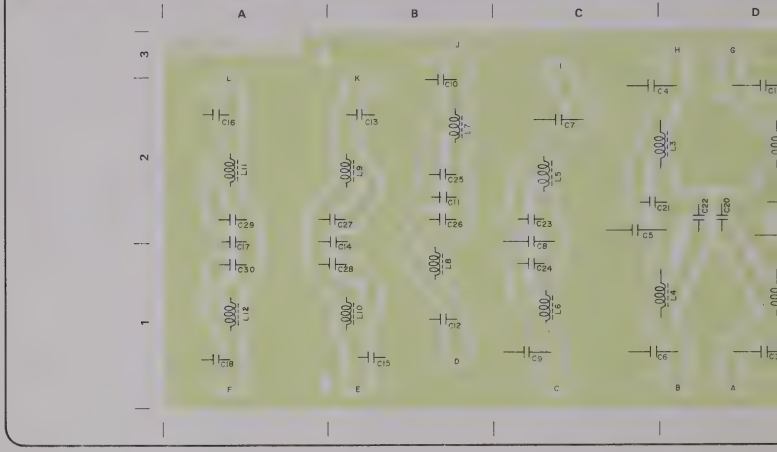
A-0158

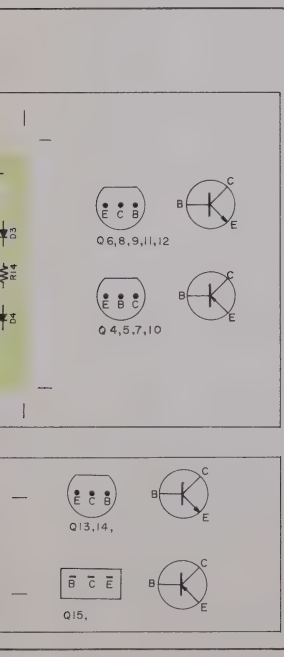


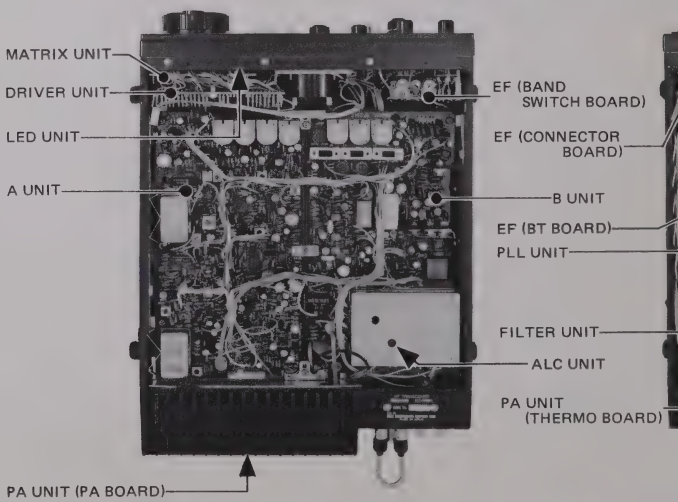


FILTER UNIT






Q6,8,9,11,12
Q4,5,7,10
Q13,14,
Q15,


MATRIX UNIT
DRIVER UNIT
LED UNIT
A UNIT
PA UNIT (PA BOARD)
EF (BAND SWITCH BOARD)
EF (CONNECTOR BOARD)
B UNIT
EF (BT BOARD)
PLL UNIT
FILTER UNIT
ALC UNIT
PA UNIT (THERMO BOARD)

In the receiving mode using the transverter, +9 Volts DC is applied through a 470 ohm resistor to J4, superimposed on the incomming signal from the transverter. Then D18, D19, and D40 are turned ON, and D28 to D33 of the RF amplifier circuit for each band are turned OFF by +9 Volts DC from J4, and D41 is turned OFF by +8 Volts DC from pin 11 of J1. Thus the incomming signal from the transverter is fed to the mixer circuit composed of D11 to D14, through J4, D18, D19, and D40.

In the transmitting mode, J4 is grounded for DC, then D16, D17 and one of D28 to D33 are turned ON and D40 is turned ON and D41 and Q2 are turned OFF by +8 Volts from Pin 11 of J1. Thus T/R relay RL1 turns to the transmit side so the mixed SSB signal from the transmit mixer circuit is fed to the RF amplifier circuit, and the amplified signal is sent to J4 through D16 and D17.

The output level is about 200mV across a 50 ohm load.

6-2-7 EXCITER CIRCUIT

The output from the RF unit J6 is applied to Q1 on the "B" unit and amplified class A to about 500mV. L3 and R6 are negative feedback circuits for obtaining the wide band characteristics from 1.8 to 30MHz. This signal is amplified class B push pull to about 7 Watts by Q2 and Q3. The junction voltage of D2 and D3 is amplified by Q9 and applied to the bases of Q2 and Q3, from the emitter of Q9, for the bias voltage.

D2 and D3 are connected to the cases of Q2 and Q3 respectively, and compensate the bias voltage by the temperature of Q2 and Q3. L8, L9, R10, and R11 are negative feedback components for obtaining a wide frequency range.

6-2-8 FINAL POWER AMPLIFIER CIRCUIT

The 7 Watt signal from the exciter stage is amplified class B push-pull in the final amplifier stage transistors, Q1 and Q2 of the PA unit to a level of about 100 Watts. Bias voltage is treated by D1, D2 and Q3, the same as D2, D3 and Q9 of the "B" unit, and fed to the bases of Q1 and Q2. L4, R7, to R10, C3, C4 and C8 are negative feedback circuits.

6-2-9 ANTENNA SWITCHING CIRCUIT

The Antenna switching circuit is composed of D24 to D26, Q4 and Q5 located on the "B" unit. Q4 is ON when the voltage for transmit (+9V) is applied to it's base through R14 during transmit. Accordingly, Q5 is turned ON, which turns on D24 which passes the RF. Q17 is OFF since it's emitter voltage is 0, and D25 and D26 are cut OFF. The signal from the PA unit is conducted to the filter section through D24. In this case, the high frequency voltage is rectified by D25 and D26 and this voltage, about 80V, is fed to the cathode of D25. This reverse biases D25 and D26 and turns them OFF, so output signals do not feed into the receive section.

In the receive mode, the base of Q4 goes to 0V, so Q4 and Q5 are turned OFF, and −9V is applied to D24 through R19 and R108, thus D24 is turned OFF completely. Also +9V is applied to D25 and D26, through Q17 and R70, so D25 and D26 are turned ON, thus incoming signals are fed to the receiving section.

6-2-10 LOW PASS FILTER CIRCUIT

The PA output, which has passed through the antenna switching circuit, is fed through the low pass filter of the filter unit, which serves to attenuate harmonics by about 40dB in order to get a clean transmit output. The low pass filter is set for each band, and is switched by the rotary relay switch. The relay switch is driven by Q1 to Q8. The voltage set in the band switching circuit on the front panel is applied to one of Q1's bases through R8, while the voltage set according to the contact of the rotary relay is applied to the other base through R12. If there is a potential difference between both bases of Q1, Q2 and Q3 amplify the DC current, and Q4 applies the bias voltage to Q5's base. As a result, the multivibrator composed of Q5 and Q6 operate and the rotary relay is driven by Q7 and Q8. The relay continues to operate until the voltage of both bases of Q1 are the same. At that time, Q1's collectors are equal, Q2, Q3, and Q4 are all OFF. Therefore Q7 and Q8 are OFF and the relay stops.

6-2-11 ALC CIRCUIT

L3 of the ALC circuit is an SWR pick up coil, and D3 and D4 are the detection diodes. The voltage of a traveling wave is detected by D3 as a negative DC voltage, and a reflected wave is detected as a negative DC voltage by D4. They pass through the SWR switch (forward-reverse switching) and operate the meter on the front panel. D1 is the ALC detection diode.

The bias voltage determined by R24 in the "B" unit is applied to the cathode of D1 through R2 in the ALC circuit. If RF voltage applied to the D1 anode is above this bias voltage, negative ALC voltage is detected by D1 and fed to the base of Q10 in the "B" unit, through L2 and R3.

The ALC output voltage is DC amplified By Q10, Q11, Q12, and Q13 in the "B" unit and then applied to the gate of Q17 in the "A" unit and controls the driving power to the PA stage. If the antenna connected to the transmitter is inferior in SWR, the detected voltage of the reflected wave is applied to the ALC output circuit Q10 in the "B" unit through D2 and R1. Therefore, the ALC output negative voltage becomes extremely high and so the driving power to the final PA stage becomes low and protects the PA transistors.

6 - 3 PLL (Phase Locked Loop) UNIT

6 - 3 - 1 LOCAL OSCILLATOR CIRCUIT

Q1-Q6 are local oscillator circuits for the conversion type PLL. Each circuit, Q1-Q6 is functional for each band respectively; for example, Q1 is for the 1.8MHz band and Q6 is for the 28MHz band. Each oscillator circuit is basically the same, being a doubler with 3rd overtone crystals.

BAND	XTAL FREQUENCY	OUTPUT FREQUENCY
1.8MHz	27.125MHz	54.25MHz
3.5MHz	28.125MHz	56.25MHz
7 MHz	30.125MHz	60.25MHz
14 MHz	33.625MHz	67.25MHz
21 MHz	37.125MHz	74.25MHz
28 MHz	40.625MHz	81.25MHz

For example, X1 of the 1.8MHz oscillator is a 3rd overtone crystal (27.125MHz) and has L2 in series, which is for the X1 oscillating frequency adjustment. The output tuning circuit connected to the Q1 collector is tuned for 54.25 MHz, which is double the frequency of the fundamental crystal oscillator frequency. The operation of Q2-Q6 is exactly the same as that of Q1, except the output frequencies are different.

6 - 3 - 2 VXO (Variable Frequency Crystal Oscillator) CIRCUIT

This circuit is for the oscillation, by 100Hz steps, of the lowest two digits (0.0 - 9.9KHz) of the VCO output frequency of the PLL circuit. The VXO circuit consists of Q7, Q8, D9, X7, L18, etc. Q8 oscillates on the 15MHz range using X7, D9, D10, and L18, and the oscillating frequency is altered in 100Hz steps by the voltage supplied from the D/A (Digital to Analog) converter.

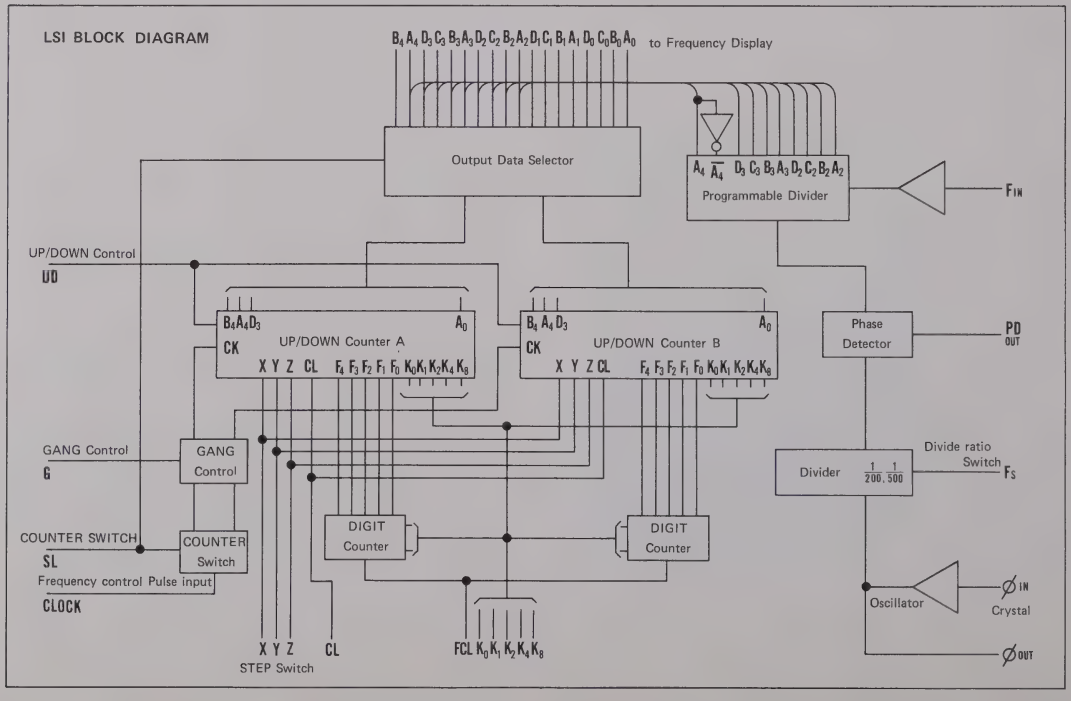
Q7 triples the output signal from Q8 and supplies about 45MHz signal to the mixer circuit of IC7.

6 - 3 - 3 MIXER AND AMPLIFIER CIRCUIT

The local oscillator output and VCO output are mixed by IC6 and the mixed signal is taken from Pins 3 and 13 of IC6. The output signal is filtered by L13 and L14, tuned for 42-44Hz, to supply the signal to IC7. The output signal of the VXO circuit is also supplied to IC7 to be mixed with the signal from IC6. The difference of these two signals (1MHz - 3MHz) is filtered by a low-pass filter and is amplified by IC8 up to the level of more than 1.6Vp-p.

6 - 3 - 4 PLL LSI CIRCUIT

The output from IC8 is the input to the LSI, Pin 2. The LSI contains PLL and control circuits. To drive the reference frequency of the PLL, a 5MHz crystal oscillator is connected to Pins 3 and 4. This frequency is divided into 1/500 by the fixed frequency divider in the LSI and becomes the accurate frequency of 10KHz. The input from Pin 2 is divided by the Programmable divider in the LSI from 1/100-1/299 which is decided by the controller, fed into the phase frequency detector with the reference frequency of 10KHz. The output is taken from Pin 40 in the form of a pulse from the phase detector according to these two input's difference of phase. The controller circuit consists of two sets of a 4-1/2 digit BCD up-down



counter for the A and B VFOs, the digit selector to control the up-down counters by a paralell data, A/B counter selector, etc.

The CLOCK (CK) and UP/DOWN (UD) signals, which is the output from the tuning knob/chopper circuit, are fed to Pins 12 and 19 respectively. The clock signal is in proportion to the rotation of the tuning knob, and the up/down signal is dependant on the direction of rotation of the tuning knob. When the UD signal is HIGH, the up/down counter increases the frequency in proportion to the number of CK pulses, and when the UD is LOW, the frequency is decreased in the same way. The signal which is determined by the "A" or "B" position of the VFO switch on the front panel, becomes the SL signal. This is fed to Pin 14 and selects either "A" or "B" set of up/down counters.

If you push the Tuning Speed button on the front panel, the signal is locked in the driver unit and fed to Pin 17 as the Y signal. In this case the Kilohertz and Hundred Hertz digits are cleared to 0, the CK signal is fed to the 10KHz digit counter, which results in high speed tuning.

The FCL K0-K8 pins of IC1 are connected to the ACC socket on the rear panel through the driver unit. When a high level signal is supplied to FCL Pin 11 and K0-K2 at the same time, the 10MHz digit figure can be reset, according to the input data at K0-K2. Then when the high level signal is supplied from K0-K8, any figure can be set according to the data from the higher digit to the lower.

For use with an EXT controller, resetting of the frequency can be accomplished in the same manner through the ACC socket.

When the Band Select switch is at the 7-28MHz position, no signal to these pins is required; however, at the 1.8MHz or 3.5MHz position, since a figure of 8 or 5 is necessary on the 100KHz digit for the bottom of each band, when switching bands or turning the power ON, a signal is supplied to these terminals. Therefore, when the Band Select switch on the front panel is at the 1.8MHz or 3.5MHz position, the high level signal is supplied to K8 to set 8 on the 100KHz digit or K4 and K1 to set 5 on the 100KHz digit respectively at the bottom of each band after the FCL input.

By the input of CK and UD signals, or by resetting the up/down counter, the output signals appear at A0-B4 and are supplied to the driver unit. The output signals of A2-A4 are supplied to the PLL programmable divider for determination of the divider ratio in accordance with the up/down.

6-3-4 LOOP FILTER CIRCUIT

The phase-detected signal from Pin 40 of IC1 is fed to the loop filter circuit of IC3. This circuit changes the output of the phase detector, which is a pulse, into a DC voltage, and also decides the response time of the whole loop. The output is used as the voltage to control the VCO frequency.

6-3-5 VCO CIRCUIT

Q11-Q16 of the VCO unit are FET modified Clapp oscillators, used separately for each band. Q11 is for the 1.8MHz band and Q16 is for the 28MHz band. To obtain the desired frequency, the D/A converter tracks the variation of the voltage supplied to the tuning diodes D11, D14, D17, D20, D23 or D26. Also, the output signal from the loop filter is supplied to the tuning diodes D12, D15, D18, D21, D24, or D27 to lock the VCO frequency.

The oscillation frequency of the VCO is equal to the displayed frequency plus about 9MHz. This output is supplied from P1 to the mixer circuit of the RF unit after the buffer amplifier Q1 and Q2. Also, the VCO output is supplied to the PLL mixer through the buffer amplifier of Q4. Q5-Q10 and D4-D9 are to switch the DC power source to Q11-Q16 according to the operating band.

6-3-6 D/A (DIGITAL TO ANALOG) CONVERTER CIRCUIT

The PLL unit has two D/A converters. R89-R94 are connected to A2-B4 of IC1 and act as a D/A converter for the higher digits. The output signal is amplified by half of IC2 for VCO tracking.

The other D/A converter is for the VXO circuit. The signals from A0-D1 of IC1 are buffered by IC4 and IC5 and supplied to R101-R109 for D/A conversion. The converted signal is fed to the other half of IC2 for off-set voltage setting and amplification to control the frequency of the VXO circuit. This D/A converted voltage changes in steps to give 100Hz step variation to the VXO frequency. Q14 and Q15 are employed to maintain linearity of the D/A converter output for changes in mode. R68 and R70 adjust the correction factor.

6-3-7 POWER CIRCUIT

The power circuit of the PLL consists of Q12, Q13, and IC9. Q13 is turned ON by C144 and applies voltage to IC9. IC9 is a voltage regulator whose output is 8.2 Volts. A part of this output is divided at R55 and R56 and is added to the base of Q12. The emitter of Q12 is connected to the collector of Q13 through a Zener diode (6.1 Volt) and therefore the collector voltage is held at 10.6 Volts. As you can see, the output of the power circuit of the PLL has outputs of 8.2 and 10.6 Volts regulated DC.

Q10 and Q11 are negative voltage regulators. One of Q11's bases is grounded and the other is connected to R53 and R54. R53 is connected to +8.2 Volts, and R54 to the collector of Q10. −9 Volts is added to the emitter of Q10 and its base is connected to the collector of Q11. Q11 works as a differential amplifier, so if there is a difference between the divided voltage at R53 and R54 and the potential of the other base, which is ground, the difference is amplified until the voltage of Q10's collector is the same value as the positive output of IC9. Therefore, the output of −8.2 Volts is achieved.

6-3-8 RIT ON/OFF CONTROL CIRCUIT

Q9 and Q17 make up the RIT ON/OFF control circuit. The voltage of the RIT IC terminal of J6 is fed to the emitter of Q17 through R51. The terminal is 0 Volts when the RIT is ON and 5 Volts when it is OFF. Q17 prevents the reverse flow from the base of Q9. The collector of Q9 is fed voltage from the RIT control and shunt to ground when the RIT is OFF.

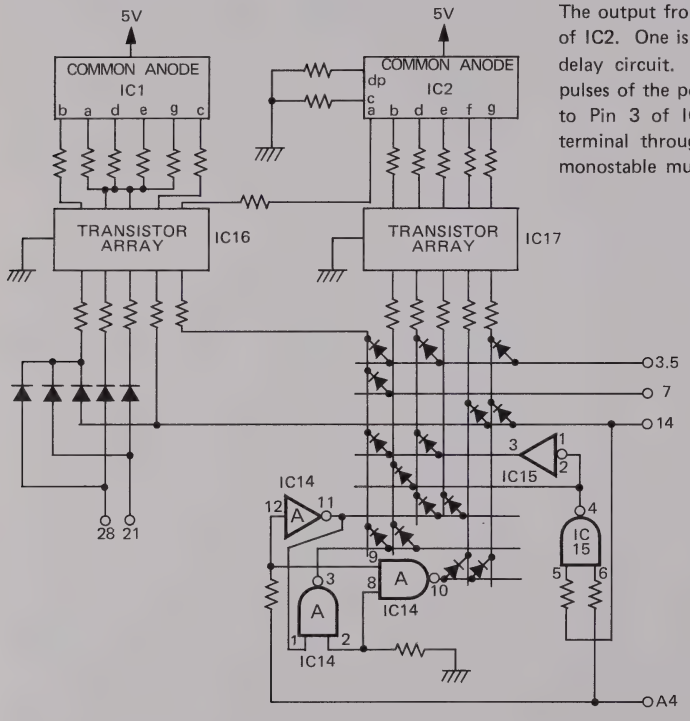
6-4 DRIVER UNIT

6-4-1 FREQUENCY DISPLAY

IC1-IC6 are the 7 segment LED indicators for the frequency display. IC3-IC6 are driven by IC22-IC25. The input for the drivers is taken from the BCD output of IC1, A0-D3 in the PLL.

IC1 and IC2 are driven by IC16 and IC17. The input of each band is decoded by IC14 and IC15 and D21-D35 to indicate the MHz and 10MHz digits.

10MHz · 1MHz DIGITS DISPLAY
SCHEMATIC DIAGRAM

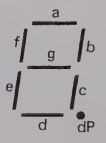


6-4-2 PHOTO-CHOPPER CIRCUIT

D38 and D39 are infrared LED diodes and Q1 and Q2 are the photo transistors. D38 sends a continuous light source to Q1 and D39 sends it to Q2. Between the diodes and the transistors is a windowed chopper disk which is connected directly to the shaft of the tuning knob. The diodes and photo transistors are set up so that the phase difference of 90 degrees results when the disc revolves. The signal from Q1 and Q2 is fed to IC1 on the driver unit. Pin 3 of IC1 is connected to the data input pin (Pin 5) of flip-flop IC3. The output from Pin 4 is divided, and fed to Pins 5 and 6 of IC2. One is fed directly and the other is fed through a delay circuit. IC2 is an exclusive OR gate IC, and both pulses of the positive edge and the negative edge are added to Pin 3 of IC3 and Q output is added to IC3's reset terminal through the delay circuit so IC3 operates as a monostable multivibrator. Q is fed to Pin 8 of IC2, the

IC14 is switched ON in 28MHz band.

BAND MHz	BAND DATA						10MHz DIGIT						1MHz DIGIT					
	3.5	7	14	21	28	A_4	a	b	c	d	e	g	a	b	d	e	f	g
1.8	L	L	L	L	L	L	–	–	–	–	–	–	–	ON	–	–	–	–
3.5	H	L	L	L	L	L	–	–	–	–	–	–	ON	ON	ON	–	–	ON
7	L	H	L	L	L	L	–	–	–	–	–	–	ON	ON	–	–	–	–
14	L	L	H	L	L	L	–	ON	ON	–	–	–	–	ON	–	–	ON	ON
15	L	L	H	L	L	H	–	ON	ON	–	–	–	ON	–	ON	–	ON	ON
21	L	L	L	H	L	L	ON	ON	–	ON	ON	ON	–	ON	–	–	–	–
28	L	L	L	L	H	L	ON	ON	–	ON	ON	ON	ON	ON	ON	ON	ON	ON
29	L	L	L	L	H	H	ON	ON	–	ON	ON	ON	ON	ON	–	–	ON	ON

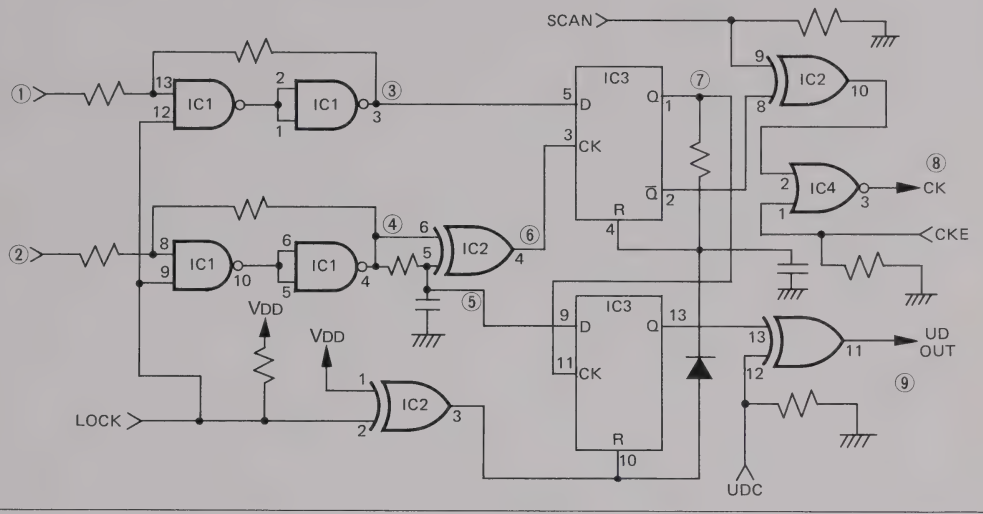


The segments "dp" and "c" of 1MHz digit are turned on in any band.

scan signal from the ACC socket (if used) is fed to Pin 9 and the output signal is fed to Pin 4 of IC4. This is controlled by the band edge detection signal, fed to Pin 1, and is sent to the LSI in the PLL unit as the Clock (CK) signal. Pin 1 of IC3 is connected to Pin 11 and the delay circuits of R13 and C3 are connected with the data input Pin 9. IC3 is a D type flip-flop, so it latches the signal of the delay circuit.

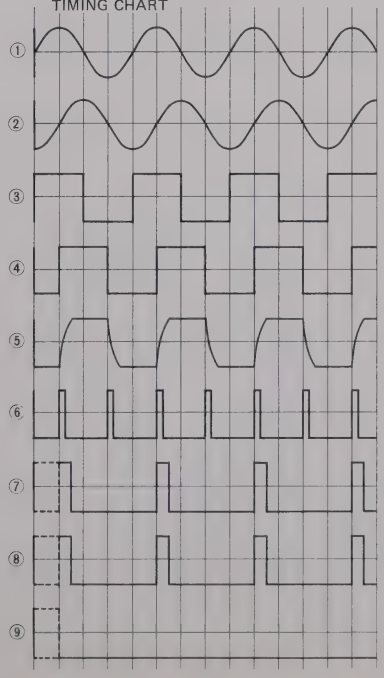
IC3 gives a High (H) level signal when the tuning knob is turned clockwise, and a Low (L) level signal when the knob is turned counter-clockwise. This (H) or (L) signal goes to Pin 13 of IC2 along with the signal from the ACC socket (if used), which is fed to Pin 12. The output of IC2 is added to the LSI as the UP/DOWN (UD) signal.

PHOTO-CHOPPER CIRCUIT SCHEMATIC DIAGRAM



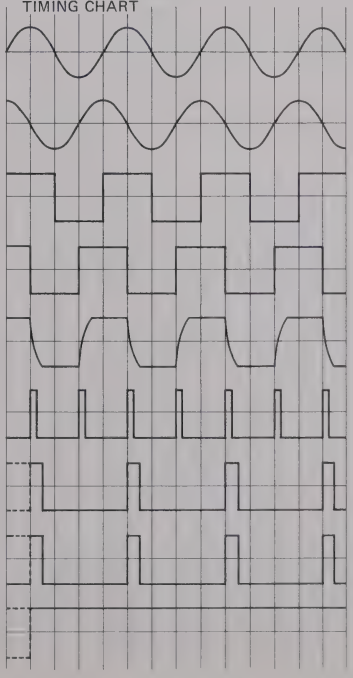
When the tuning knob is turned counter-clockwise

TIMING CHART



When the tuning knob is turned clockwise

TIMING CHART

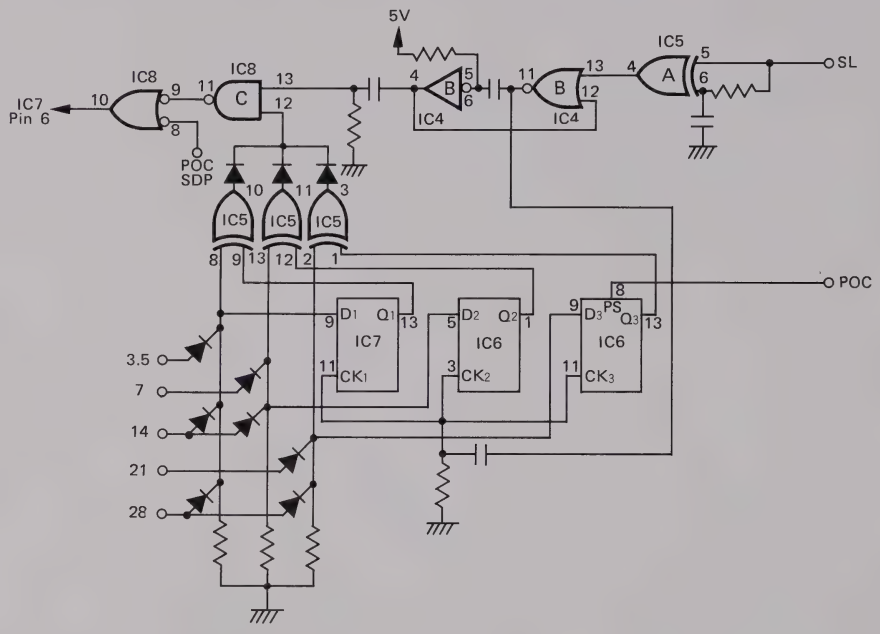


6-4-3 MEMORY CONTROL CIRCUIT

Pin 5 of IC5 is connected to the VFO switch on the front panel and changes from H to L or L to H if the switch is changed. The delay circuits R17 and C5 are connected to Pin 6 so pulses of positive edge and negative edge are taken out and fed to Pin 13 of IC4. The monostable multivibrator is made up of IC4, a NOR gate circuit, and an inverter. The Low level pulse output is taken from Pin 11 and the High level pulse from Pin 4. IC6 and IC7 are the 3 bit band memory circuits. The chart shows the band codes assigned to each.

BAND	IC7 Pin13 bit 0	IC6 Pin 1 bit 1	IC6 Pin13 bit 2
1.8MHz	L	L	L
3.5MHz	H	L	L
7 MHz	L	H	L
14 MHz	H	H	L
21 MHz	L	L	H
28 MHz	H	L	H

MEMORY CONTROL CIRCUIT SCHEMATIC DIAGRAM



The exclusive OR gates made up of three units of IC5 compares the contents of this memory with the band codes consisting of D5-D11. If they are the same, Pin 12 of IC8 goes LOW, and if they are different, it goes HIGH. A one-shot pulse from Pin 4 of IC4 is fed to Pin 13 of IC8 and as it is a NAND gate IC, its output is taken from Pin 11 only when the memories are different. If a one-shot pulse is generated, the pulse is added to Pin 11 and Pin 3 of the CK terminals of IC6 and IC7 when its pulse is terminated and the output of the band code is added to the D input, and this band is memorized.

The output of IC8, Pin 11, is connected with Pin 9. The Power On Clear (POC) pulse, which becomes a 100ms HIGH level pulse when the power source switch is turned ON, and the SDP pulse which occurs when the band is changed, are input to Pin 8. So it follows that Pin 10 of IC8 is supplied with a HIGH level pulse in both cases.

6-4-4 BAND EDGE DETECTION CIRCUIT

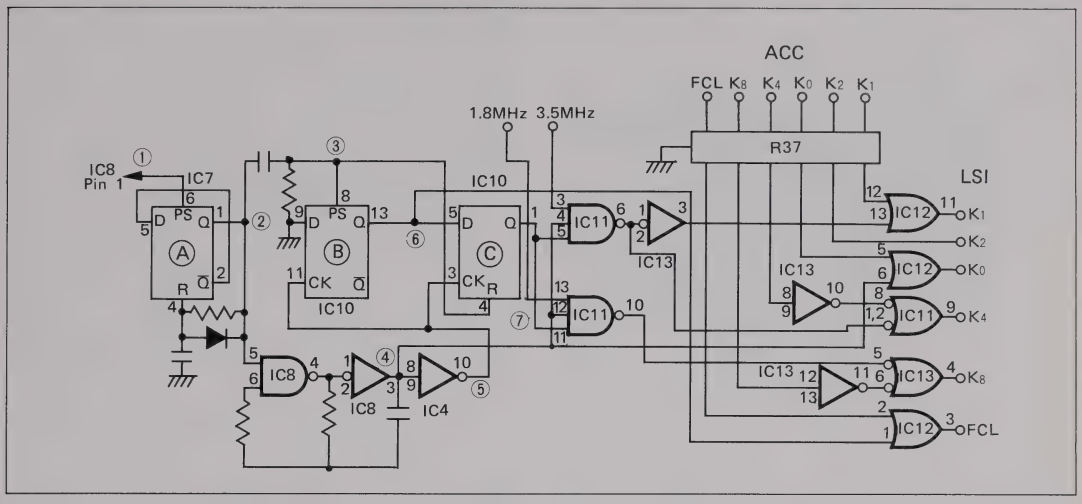
The output of IC8 Pin 10 is combined with IC7 Pin 6. This works as a monostable multivibrator since this is added to Pin 4 of RESET from the Q output through the delay circuit. Pin 1 of IC7 is fed to IC8 Pin 5 and to IC10 Pin 8 of the RESET through the differentiation circuitry. Pin 1 of 2 gates of IC8 works as a multivibrator and gives off about seven pulses for one shot pulse from Pin 1 of IC7.

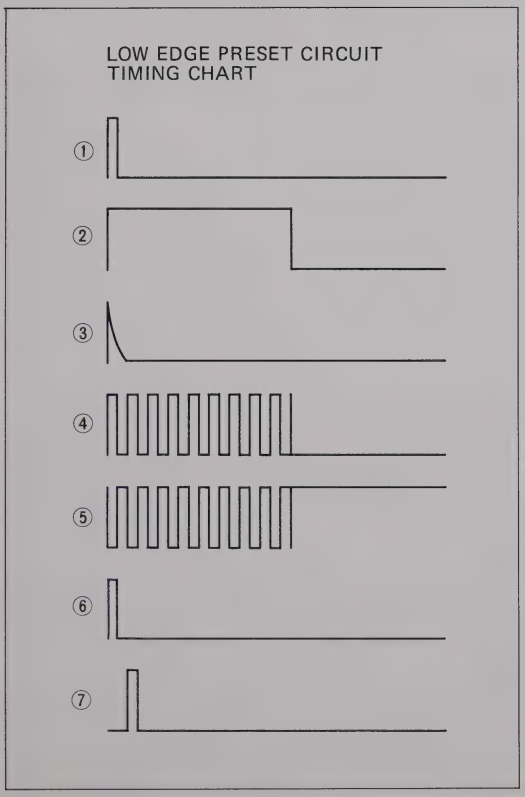
IC10 works as a 2 bit shift register and at first Pin 13 goes HIGH, and Pin 1 goes LOW by the one-shot pulse from IC7. Then the output of IC8 is added to Pin 3 and Pin 11 of the CK terminals through the inverter IC4 and under the circumstances preset by the input of IC7, Pin 13 is HIGH, and Pin 1 is LOW. The output of Pin 13 is fed to Pin 1 of IC12 and since this is an OR gate, it's output, fed to IC1 in the PLL unit becomes the FCL signal. If the first pulse from the output of the inverter, IC4, goes to IC10, Pin 13

goes LOW and Pin 1 goes HIGH. When the band is 1.8MHz, Pin 13 of IC11 is HIGH and Pin 11 is connected with Pin 1 of IC10, so it is HIGH.

As Pin 12 is connected to the front of the inverter of the oscillator circuits, the three input gates of IC11 are all HIGH in the next half cycle, and the output from Pin 10 goes LOW. IC13's output HIGH level pulse is fed to IC1 in the PLL as K8, therefore the 100KHz digit is set at 8.

When the band is 3.5MHz, it is input to K1 and K4 through the same process and the 100KHz digit is set to 5. As the 100KHz digit begins with 0 in upper bands from 7MHz, this operation is not necessary. When the band is 7MHz or





above, the band data of 1.8MHz and 3.5MHz are LOW, so pin 6 and Pin 10 of IC11 are always HIGH and this circuit does not work.
After the third pulse from IC8, it is used together with the low edge of the band and fed to IC1 in the PLL as the K0 input.

6-4-5 MATRIX CIRCUIT

The output A0-A4 of the LSI and the signal of each band make up the matrix circuit and this decides the edges of each band.

The band edges are as follows:

BAND	LOW EDGE	HIGH EDGE	FAST TUNING
1.8MHz	1.800.0	1.999.9	1.990.0
3.5MHz	3.500.0	3.999.9	3.990.0
7 MHz	7.000.0	7.499.9	7.490.0
14 MHz	14.000.0	15.199.9	15.190.0
21 MHz	21.000.0	21.499.9	21.490.0
28 MHz	28.000.0*	29.999.9*	29.990.0*

* In the 28MHz band the tuning does not stop when the band edge is reached. It automatically reverts to the other band edge and continues tuning either up or down.

IC21, IC20, and IC18 of the driver unit detect the 0 in the 10KHz, 1KHz, and 100Hz digits. Since they are AND gate circuits, they detect when all three figures are 0, and are used to control the low edge. IC19 detects 0 of the 100KHz level, but it is necessary to distinguish the 1.8MHz

and 3.5MHz bands from other bands since their 100KHz low edge digits are not 0.

D42-D45 detect the lower two figures (9.9) and D40 and D41 detect (9) of the 10KHz level. It is necessary to distinguish these from others since the lower two figures are reset to 0 when the dial tuning speed button is pushed. Q6 is the gate for this distinction. The MHz level and the 100 KHz level of the band edge are determined by the detection of the (0) and (9), the figures which are chosen according to the band of the matrix unit and the matrix which composes the necessary data out of A0-B4 of the output from IC1 in the PLL section "line". Moreover, three kinds of AND gates with the UD signal are taken out and if they agree with each other, CKE output is achieved. If this controls IC4 Pin 4 and becomes the band edge, the CK signal is stopped.

6-4-6 RIT CONTROL CIRCUIT

Once the RIT switch is pushed down, Pin 12 and Pin 13 of IC27 become HIGH. Any chatter from the switch is absorbed by the delay circuit of R66 and C20. Also the two gates of IC27 are used as inverters and the square pulse is achieved by the Schmitt trigger circuit. The output from IC27 Pin 10 goes to IC28 Pin 3 of the CK terminal. This IC works as a T type flip-flop so the level is reversed every time the RIT switch is pushed. The signal at Pin 1 of IC28 (Q output) is fed to Q15 through R62 and turns ON this transistor. Q15's collector is connected with D4, an LED, so when Q15 conducts, the LED is lit and indicates that the RIT circuit is ON. The LED also indicates the center of the RIT control.

Also Pin 1 of the IC28 is fed to Pin 6 of IC27 as well and it functions with the send signal HIGH level during receiving, of Pin 5. The output of Pin 4 switches Q9, in the PLL circuit, and controls the RIT circuit.

6-4-7 DIAL LOCK CIRCUIT

If the dial lock button is pushed, Pin 1 and Pin 2 of IC27 go LOW. Any switch chatter is absorbed by R6 and C19. The output of IC27 inverter is fed to Pin 11 (CK terminal) of IC28. IC28 also works as a T type flip-flop and output levels are repeated every time the input is applied. The Q output from Pin 13 turns Q4 ON, through R69, and shows that the dial lock button has been pushed, by lighting the dial lock indicator LED, D2. Also Pin 9 and Pin 12 of IC1, and Pin 2 of IC2 are connected to Q4's collector and they go to LOW level, so the clock pulses from Q1 and Q2, the photo transistors, are not fed to the LSI circuit, and the frequency is locked.

6-4-8 TUNING SPEED CIRCUIT

If the tuning speed button is pushed, the input goes to Pin 3 of IC29 through C16. R59 and C17 absorb any chattering. IC29 is also a T type flip-flop. The Q output of Pin 1 is combined with Q3. This makes the dial fast LED indicator, D1, light. Also, the signal from IC29 Pin 2 ($\overline{Q}$) is sent to the LSI circuit and the Y terminal (Pin 17) of IC1 in the PLL unit goes HIGH, and so fast tuning is achieved.

6-5 POWER UNIT

6-5-1 13.8 VOLT DC REGULATED POWER SUPPLY CIRCUIT

Voltage supplied to Pin 1 (ground) and Pin 2 (positive) of the power source connector J6 on the rear panel is fed to the reverse polarity protection circuit composed of diodes D9, D10, and Fuse F1. This voltage serves as a direct power source for the final amplifier stage of the IC-701. Power for all other circuits is fed through the power switch located on the front panel. Voltage passing through the power switch is fed to the PLL unit and distributed to the 13.8 Volt regulated power supply circuit. This supply is composed of transistors Q13 through Q15 in the PA unit and will reduce a voltage applied to the power source connector to 13.8 Volts when the voltage exceeds that. The output voltage of this circuit is fed to the "B" unit, AF power amplifier circuit, dimmer circuit, and at the same time, serves as an input power source for each 9 Volt regulated power circuit.

6-5-2 9 VOLT REGULATED POWER SUPPLY CIRCUIT

Regulated –9 Volts is produced using the DC-DC converter, IC2, in the "B" unit. The regulated power supply circuit for +9 Volts is composed of Q40, Q42, Q43, and D36 in the "A" unit. D36 detects the difference between output voltages and Q42 and Q43 amplify it. Then Q41 controls the voltage. The regulated 9 Volt supply for receive is taken from the emitter follower circuit of Q37 to the base of which the 9 Volt standard voltage of D36 is fed. In the transmit mode, the base of Q37 is connected to ground by the PTT switch or Q9 through D26 and the output voltage ceases. The 9 Volt supply for transmission is taken from the emitter of Q39, and its base is supplied with the 9 Volt standard voltage through D30. In the receive mode, the base of Q39 is connected to ground through Q38 being ON and the output voltage ceases.

6-6 OTHER CIRCUITRY

6-6-1 THERMO-SENSOR CIRCUIT

This circuit controls forced air cooling for the final stage of the transmitter when the temperature of the final transistors become excessively high. The temperature of the transistors is detected by the POSISTOR R13 to vary base bias of Q4. Q4 and Q5 compose a Schmitt trigger circuit whose output is amplified by Q6 and Q7 to turn ON and OFF the DC fan motor. Another Schmitt trigger circuit composed of Q8 and Q9 is provided to turn ON Q10 if the final stage transistor temperature rises dangerously high. The voltage built up by D6 and R38 through Q10 conducted varies the bias for the constant voltage circuit in the motor to run it at high speed. With this high speed, the fan gives more air flow through the heatsink which keeps the temperature of the final stage transistors low

enough to prevent damage. To indicate the dangerously high temperature, all the luminous indicators on the front panel begin blinking. This is done by the autodimmer circuit composed of Q14, and Q15. The output of the free running multivibrator, Q11 and Q12, and driven by the voltage through Q10 is applied to the circuit.

6-6-2 AUTODIMMER CIRCUIT

R20 in the driver unit is a cadmuim sulfide (CdS) element to detect brightness of the surrounding light. It's output is applied to the Schmitt trigger circuit composed of Q14 and Q15 through the dimmer change over switch in the "B" unit. The output of this circuit is connected to Q16 which conducts when the surroundings are bright and a voltage of about 12.5 Volts is obtained from the emitter of Q16. This voltage turns ON lamps through D9. The output from the emitter of Q16 through R66 is fed to the Zener diode (D37) in the "A" unit to obtain 5 Volts which is driven by Q1 to light each LED. When the surroundings are dark, Q16 turns OFF and the voltage for lamps on the front panel is fed from the 13.8 Volt line through R20 (47 ohms) which drops the supply voltage for lamps to about 8.5 Volts. With Q16 in the "B" unit is OFF, a voltage of about 7 Volts is obtained from the Zener diode D8 and fed to R66 through D28. This voltage is reduced by half with R66 and R247 in the "A" unit and driven by Q1 to light each LED with about 2 Volts.

6-6-3 VOX AND CW BREAK-IN CIRCUIT

The voice signals from the microphone are amplified by Q18 through Q20 and detected by Q21 to drive Q22. Q22 switches the power supply line ON and OFF corresponding to voice signals. C78, R120 (VOX DELAY control) and R121 compose a circuit to determine the time constant to the VOX circuit. The output of this circuit is amplified by Q7 and Q8 to drive Q9 to switch the transmit circuit ON and OFF. The anti-VOX circuit prevents erroneous operation of the VOX circuit caused by sound from the speaker. Signals from the speaker are amplified by Q24, Q25, and Q26 through R131 (ANTI VOX GAIN Control). These are then fed to Q23 to raise emitter voltage of Q21 which reduces the sensitivity of the detector circuit.

The CW break-in circuit is composed of Q5 and Q6 amplifying the signals from the key at Q5 and feeding it to Q6 for switching the power supply voltage ON and OFF. This ON-OFF voltage is fed to the circuit composed of C14, R32 (CW DELAY Control) and R33 having the specified time constant to control the transmit circuit by way of Q7, Q8, and Q9.

6-6-4 CW MONITORING CIRCUIT

Q7 in the "B" unit is a CR phase shifting oscillator whose frequency is set to about 900Hz. Q8 is a switching circuit to make and break a ground path for C45 so as to vary the gain of Q7 for switching the oscillation ON and OFF. The oscillating output passing through R32 (CW MONI volume control) is fed to the 8th Pin of the AF amplifier circuit IC1 to drive the speaker.

AC POWER SUPPLY

This set is designed to operate on 13.8 Volts DC. However, a special AC power supply, the IC-701PS is available for AC operation. The IC-701PS provides 13.8 Volts at 20 Amps. When connected to the IC-701 transceiver, the power supply ON-OFF operation is remotely controlled by the power ON-OFF switch on the IC-701.

■ SPECIFICATIONS

• Number of Semi-conductors:	Silicon diode	3
	LED	1
• Input Voltage (suitable voltage):	117/230V AC (50/60Hz)	
• Allowable voltage fluctuation:	±10% of input voltage (suitable line voltage)	
• Input Capacity:	360VA (at 20A load)	
• Output Voltage:	DC13.8V (at 20A load)	
• Max. Load Current:	20A (10 minutes ON/10 minutes OFF 50% duty cycle)	
• Polarization:	Negative ground	
• Internal Speaker:	125 x 77 mm 2 watt nominal input 4 watt maximum	
• Dimensions:	110(H) x 180(W) x 260(D) mm	
• Weight:	Approximately 8 kg	
• Accessories included:	AC power cord	1
	Spare fuse	2
	Speaker cord	1

SECTION 7 MAINTENANCE AND ADJUSTMENT

This set has been completely adjusted and checked at the factory so no adjustment should be necessary. However, during prolonged use, the preadjusted oscillating frequency, etc. may need slight adjustment. If this becomes necessary, the following procedures should be followed. As the adjustments other than those specified herein require high skill and expensive equipment, for best results the set should be sent back to the dealer or ICOM distributor for adjustment.

7 - 1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

(1)	FREQUENCY COUNTER	
	FREQUENCY RANGE	1 - 90MHz
	ACCURACY	BETTER THAN ±1 ppm
	SENSITIVITY	100mV or BETTER
(2)	SIGNAL GENERATOR	
	FREQUENCY RANGE	1.8MHz - 30MHz
	OUTPUT VOLTAGE	–20 - 90dB (0dB =1 μV)
(3)	MULTIMETER	20KΩ/Volt or better
(4)	AC MILLIVOLTMETER	
	MEASURING RANGE	100-200mV
(5)	RF VOLTMETER	
	FREQUENCY RANGE	1.8-30MHz
	MEASURING RANGE	0.1-1V
(6)	RF WATTMETER	
	MEASURING RANGE	20-100 Watts
	FREQUENCY RANGE	1.8-30MHz
	IMPEDANCE	50 OHMS
	SWR	LESS THAN 1.1
(7)	AF OSCILLATOR	
	OUTPUT FREQUENCY	200-3000Hz
	OUTPUT VOLTAGE	0-100mV
	DISTORTION	LESS THAN 0.1%
(8)	OSCILLOSCOPE	SYNCROSCOPE
(9)	DIGITAL VOLTMETER	
	MEASURING RANGE	0.001–10V 3-1/2 DIGITS

7 - 2 RECEIVER ADJUSTMENT

7 - 2 - 1 BFO FREQUENCY ADJUSTMENT

The BFO oscillator frequencies differ in accordance with each mode and for transmitting and receiving operation. Adjust corresponding trimmer capacitors and trimmer resistors as shown in the table below. Connect the input terminals of the frequency counter across the lead wire of the BFO output D10, or D11, in the B unit, and ground. Connect a digital voltmeter to the cathode of D36 of the "A" unit and check voltage for 8V DC ±100mV. Adjust R202 as necessary for 8V. This is a critical adjustment.

(a) Place the set in receive. Make frequency adjustments as follows.

RECEIVE OPERATION

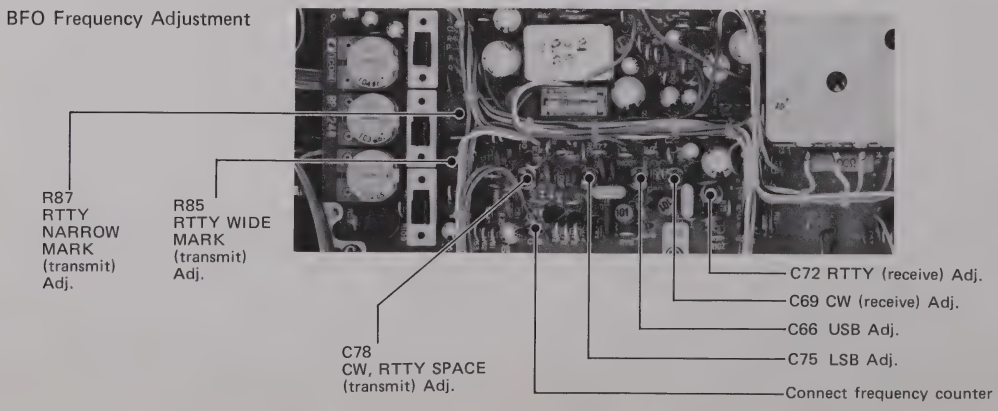
MODE	ADJUSTING POINT	BFO OUTPUT FREQUENCY
USB	C66 (B unit)	9.01300 MHz (note 2)
LSB	C75 (B unit)	9.01000 MHz (note 2)
CW (CW-N)	C69 (B unit)	9.01320 MHz
RTTY	C72 (B unit)	9.014525MHz

(b) Turn ON the speech processor (COMP) but keep the knob fully counterclockwise to supress RF power from being transmitted. Then place the set in the transmit mode.

MODE	ADJUSTING POINT	BFO OUTPUT FREQUENCY
CW (CW-N)	C78 (B unit)	9.01240MHz
RTTY	R87 (B unit) (S3 in B unit to N)	9.01223MHz (note 1)
	R85 (B unit) (S3 in B unit to W)	9.01155MHz (note 1)

NOTE 1:
S3 in the "B" unit is a change over switch (RTTY Switch) for narrow modulation (170Hz shift width) and wide modulation (850Hz shift width) RTTY transmission, which is located under the access cover.

NOTE 2:
Fine adjustment for the SSB carrier point should be performed in accordance with adjustment "4", CARRIER POINT ADJUSTMENT, in the transmitter section adjustment procedures.



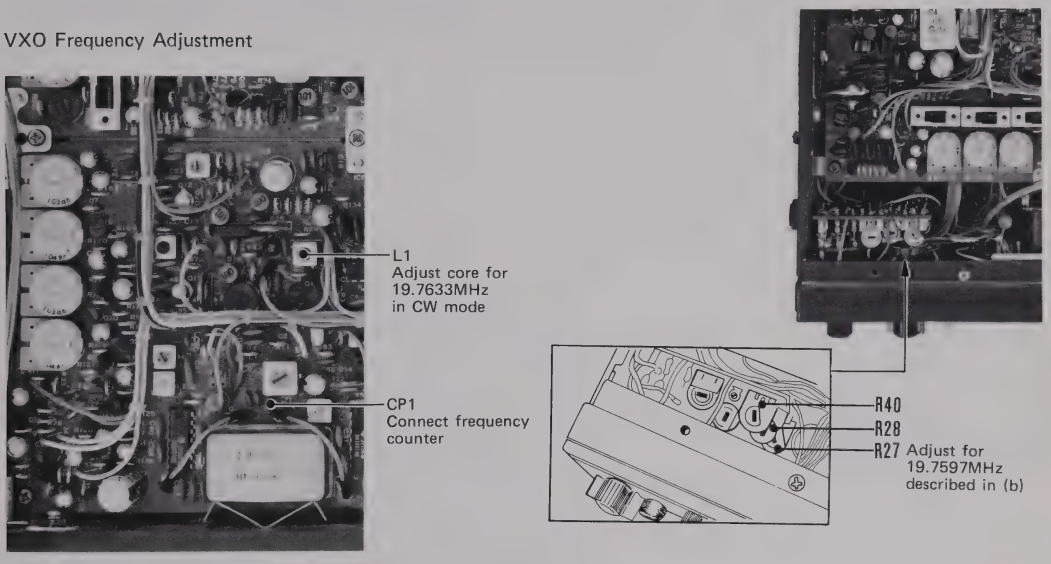
7-2-2 VXO FREQUENCY ADJUSTMENT

Connect the input terminals of the frequency counter across CP1 and ground of the "A" unit and perform the following adjustments.

(a) Place the set in receive in the CW (P.B. TUNE control centered) and adjust coil L1 for a frequency of 19.76330MHz.

(b) Then set the mode to USB or LSB and adjust R28 on the front inside of the set to obtain 19.75970MHz with the P.B. TUNE knob turned fully counter-clockwise. Set P.B. TUNE knob to the center position and adjust R27 for 19.7615MHz. R28 and R27 adjustments interact so repeat several times unit no further change is noted. Set P.B. TUNE knob fully clockwise. If previous adjustments are correct, frequency should read 19.7631MHz.

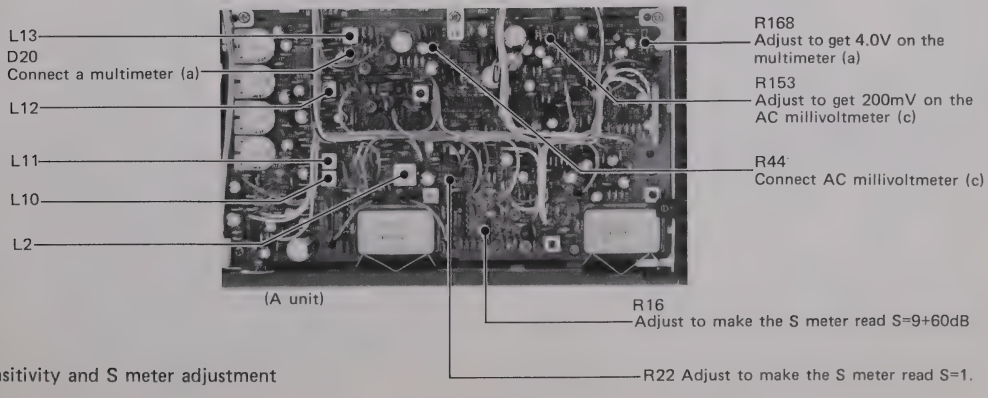
VXO Frequency Adjustment



7-2-3 AGC SENSITIVITY AND S METER ADJUSTMENT

With the receive frequency set to 14MHz, mode to USB AGC fast, RF GAIN fully clockwise, connect the signal generator to the antenna connector. MAKE SURE THAT THE SET IS IN THE RECEIVE MODE!! IF NOT, THE GENERATOR WILL BE DAMAGED!!

(a) Adjust the signal generator output to minimum and connect the multimeter set to the 10 Volt DC range across the plus lead of D20 in the "A" unit and ground. Make sure no signal is applied to the set. Adjust R168 in the "A" unit to get 4.0 Volts on the multimeter.



Sensitivity and S meter adjustment

(b) Adjust the signal generator frequency to the receive frequency (so that a beat note is heard) and set the signal generator output to make the S meter read S=5. Adjust coils L2, L10, L11, L12, and L13 in the "A" unit to get the maximum deflection on the S meter. If operating properly, a 4dB signal at the antenna terminal should read S1. If the reading is slightly off, minor adjustment of L1 and L5 on the RF unit may correct the discrepancy.

(c) Increase the signal generator output to +90dB (+84dB loaded) and adjust R153 in the "A" unit to obtain 200 milli Volts on the AC millivoltmeter connected across the lead of R44 and ground.

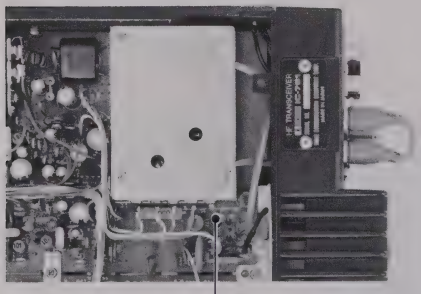
(d) S meter adjustment begins with setting the signal generator output to 4dB and adjusting R22 to make the S meter read S1. Then increase the signal generator output to 84dB and adjust R16 to make the S meter read S9+60dB. If this adjustment is required, readjustment of the speech processor is necessary.
NOTE:
DO NOT ADJUST L5, L6 or L9 as ripple will result.

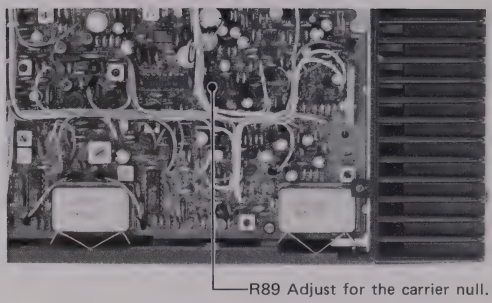
7-3 TRANSMITTER ADJUSTMENT

First, connect an RF wattmeter (impedance of 50 ohms) to the antenna connector.

7-3-1 CARRIER SUPPRESSION ADJUSTMENT

Place the set in the transmit mode in USB or LSB, 14MHz band, the compressor OFF and the MIC GAIN fully counter-clockwise. Connect an RF voltmeter (set to a high voltage scale) across the lead of D24 in the "B" unit and ground. With an appropriate meter range to have suitable deflection for reading, adjust R89 in the "A" unit for minimum.





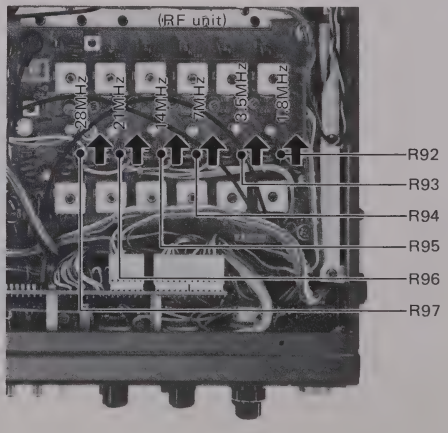
7-3-2 GAIN ADJUST (FOR EACH BAND)

Each amplifier stage, mixer stage, etc., has variations in gain at different frequencies. This requires individual adjustment of the ALC and Compressor levels at every band selection. This set provides a gain adjustment circuit for each band and by presetting these circuits, easy operation can be expected. The following is the adjustment procedure.

(a) Place the set in transmit, RTTY, 1.8MHz and adjust the compressor knob to obtain 20 Watts indication on the RF wattmeter. Turn R92 in the RF unit for maximum RF power and adjust the compressor knob again for 20 Watts indication on the RF wattmeter. (DON'T READJUST THE COMPRESSOR KNOB HEREAFTER).

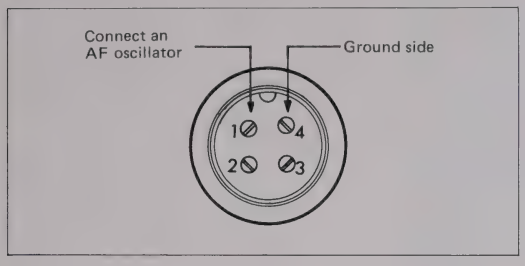
(b) Set to receive, change bands to 3.5MHz and set again to Transmit. Adjust R93 in the RF unit for maximum RF output. Turn R93 in the direction as indicated by the arrow to set the RF power to 20 Watts.

(c) Similarly, adjust R94, R95, R96, and R97 for maximum RF output in the 7, 14, 21, and 28MHz respectively and turn each resistor in the direction as indicated by the arrow to set the RF output to 20 Watts.



7-3-3 COMPRESSOR CIRCUIT ADJUSTMENT

Place the set in the transmit mode in USB at 14MHz and turn the compressor and mic gain knobs fully clockwise. Then as shown in figure, connect the AF oscillator across Pin 1, the input, and pin 4, ground, of the mic connector and apply an input of 100mV, at 1000Hz. Turn R68 fully in the direction as indicated by the arrow. (clockwise)



(a) Place the meter switch to ALC and adjust R25 so that the meter indicates 60% on the Po scale.

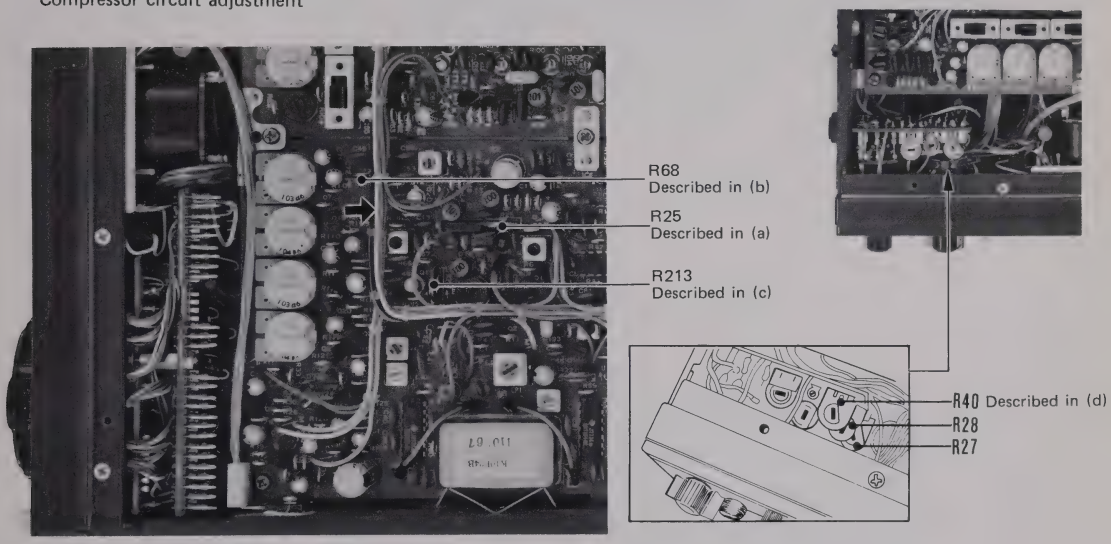
(b) Adjust R68 in the "A" unit so that the meter indicates 50% on the Po scale.

(c) Place the meter switch to COMP and adjust R213 in the "A" unit so that the meter indicates its full scale.

(d) Then turn the mic gain knob on the front panel fully counter-clockwise and adjust R40 so that the meter just begins to swing and set it in that position.

(e) Performing the adjustment shown in (d) will affect the adjustments done in (c). Repeat adjustments in (c) and (d) until no difference is present.

Compressor circuit adjustment



7-3-4 CARRIER POINT ADJUSTMENT

Place the set in transmit in USB at 14MHz and turn the compressor OFF with the mic gain knob turned fully clockwise. Connect the AF oscillator across Pin 1 (input) and Pin 4 (ground), of the mic connector.

(a) Set the frequency of the AF oscillator to 270Hz and the output at a level that gives approximately 20 Watts output on the watt meter.

(b) Then vary the AF oscillator frequency to 2700Hz and adjust C66 in the "B" unit to obtain 20 Watts on the meter.

(c) Performing the adjustments shown in (b) will affect the adjustment done in (a). Repeat adjustments in (a) and (b) until no difference is present.

(d) Place the MODE switch to LSB and adjust C75 the same as the adjustments done in (a), (b) and (c) using C75.

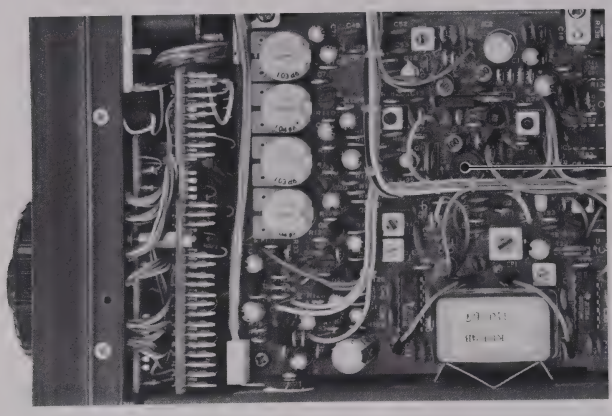
7-3-5 SPEECH PROCESSOR ADJUSTMENT

When the compressor is turned ON, the SSB signal passes through the crystal filters FL1 and FL2 in the "A" unit. Since the rated center frequencies of these filters differ from the actual center frequencies by a certain amount, deterioration of audio quality results due to narrowing of the SSB band width. To eliminate this problem, the VXO frequency is shifted to cover the drift mentioned above in the following adjustments. Place the set in the transmit mode in USB at 14MHz with the mic gain and compressor knobs turned fully clockwise and connect the AF oscillator output across of the mic connector as before with the frequency set at 2600Hz.

(a) With the MODE switch in USB, adjust the AF oscillator output level to obtain 20 Watts output on the Watt meter.

(b) Then change the mode to LSB and adjust R2 in the "A" unit to obtain the same 20 Watts.

(c) Repeat the adjustments in (a) and (b) until the RF output for USB and LSB are the same. (20 Watts).

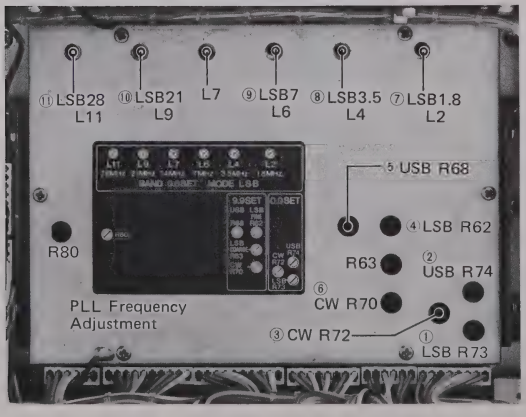


7-4 PLL UNIT ADJUSTMENT

7-4-1 FREQUENCY ADJUSTMENT

This adjustment can be performed without removing the PLL unit seal. Remove the plug from J2 in the RF unit and connect the counter to coax 2 — output of VCO low pass filter. Select the 1.8MHz band and open the top cover to place the FREQ SET control to the 12 o'clock position. Align the frequencies referring to the counter display as shown in the following table.

MODE	FREQUENCY DISPLAY	ADJUSTING POINT	DESIRED FREQUENCY
① LSB	14.000.0	R73	23,010.0KHz
② USB	14.000.0	R74	23,013.0
③ CW	14.000.0	R72	23,012.4
④ LSB	14.009.9	R62	23,019.9
⑤ USB	14.009.9	R68	23,022.9
⑥ CW	14.009.9	R70	23,022.3
⑦ LSB	1.800.0	L2	10,810.0
⑧ LSB	3.500.0	L4	12,510.0
⑨ LSB	7.000.0	L6	16,010.0
⑩ LSB	21.000.0	L9	30,010.0
⑪ LSB	28.000.0	L11	37,010.0



7-4-2 VCO COIL ADJUSTMENT

Measure the voltage at Pin 5 (PD) of J1 in the VCO unit with the multi-meter or oscilloscope taking care to avoid accidential shorts or grounds. As the measured voltage will vary to both polarities, a calibrated, syncroscope should be used for ease of adjustments. The adjustments should be performed as follows.

The ideal voltage range as we tune from one end of a band to the other is –3V to 0V. The –3 Volt level is maximum and must not be exceeded. Initially check for the maximum positive voltage and set it to zero with the adjustment shown for the band. Then tune through the band for the low voltage. If it is more positive than –3V, no further adjustment is necessary. If the low point is more

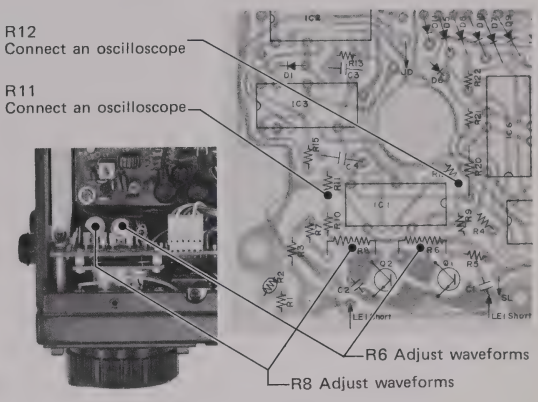
negative than –3 Volts, readjust the control for –3 Volts maximum negative. You will then find that the hi point will swing positive. Up to +4 Volts is acceptable.

Tune over all bands with the tuning knob placed in the dial fast mode and make sure the voltage at J1 PIN 5 falls within –3 to +4 Volts. If not, repeat the adjustments.

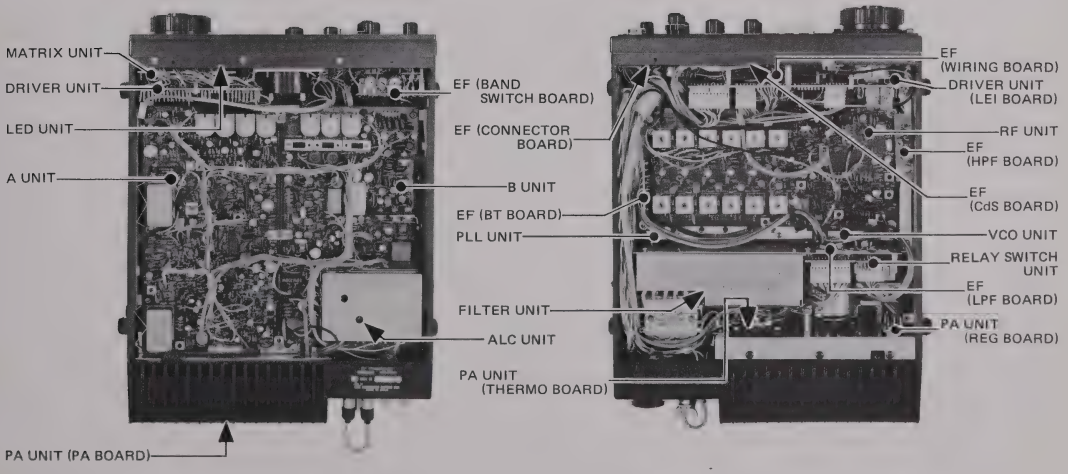
BAND	VOLTAGE AT J1 PIN 5	ADJUSTING POINT
1.8MHz	–1 ~ –2V	L3
3.5MHz	〃	L4
7 MHz	0 ~ –1V	L5
14 MHz	+1 ~ 0V	L6
21 MHz	0 ~ –1V	L7
28 MHz	+1 ~ +2V	L8

7-4-3 DISPLAY UNIT ADJUSTMENTS

Set the oscilloscope to the DC 1 to 2V/cm and connect it to R11 and release the brake of the tuning knob. Then turn fast the tuning knob and adjust R8 so that vertically symmetrical waveforms are obtained. Similarly, connect the oscilloscope to R12 and adjust R6. After adjustment, lock the tuning knob again.



UNIT LAYOUT



SECTION 8 TROUBLE SHOOTING

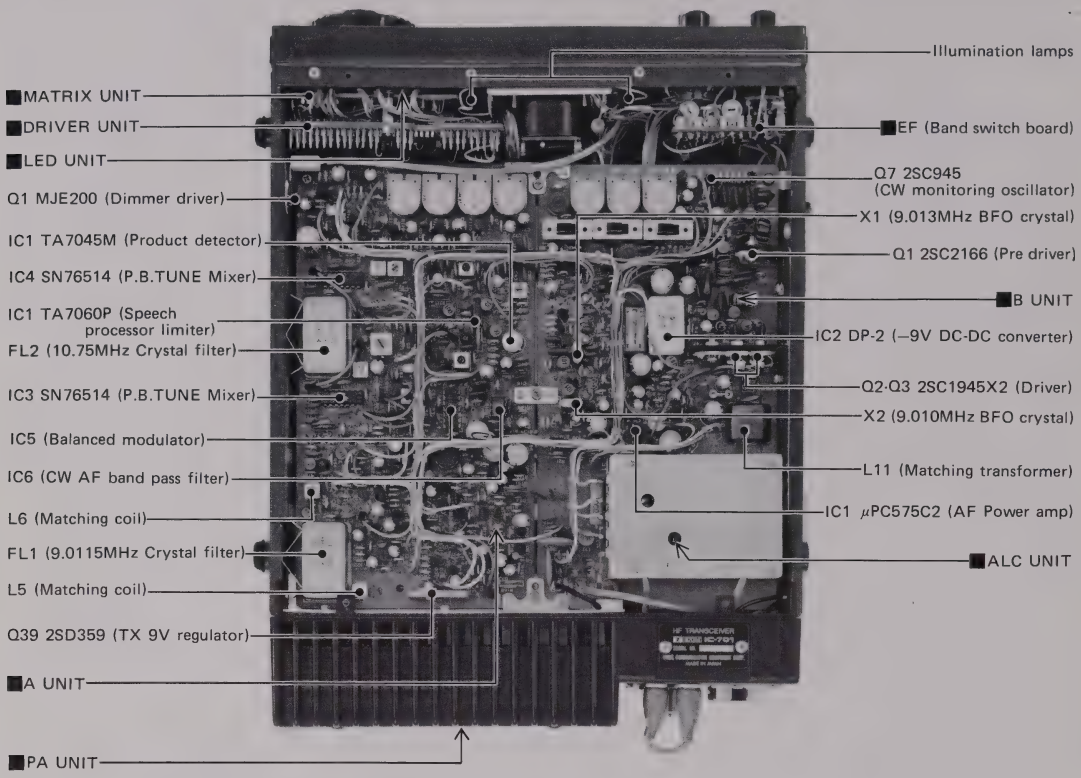
Your IC-701 has been tested very carefully at the factory before shipping. The chart below has been designed to help you correct any problems which are not equipment malfunctions. If you are not able to locate the problem and/or solve it through use of this chart, please contact your dealer or ICOM distributor for assistance.

Problem	Possible Cause	Solution
1. Power does not come on when the switch is pushed.	Power cable is improperly connected.	Carefully reconnect power cable.
	Power cord is connected with the polarity reversed.	Disconnect the power cord, replace the blown fuse, then reconnect the power cord observing proper polarity.
	Blown fuse.	Check for the cause, then replace the fuse with a spare one.
		If using an IC-701PS, also check it's fuse.
	IC-701PS MAIN switch is in the OFF position.	Place MAIN switch in ON position.
2. The frequency display on the LED's keeps changing bands and a clicking noise is heard.	The Band Select switch is in the EXT. position.	Set the Band Select switch to the desired band.
3. No sound comes from the speaker.	AF GAIN Control knob is completely counterclockwise.	Turn the knob clockwise to a suitable level.
	The unit is in the transmit mode, either by the T/R switch or the PTT switch on the microphone.	Put the unit in the receive mode.
	The external speaker cable is connected to the unit but not to the external speaker jack on the power supply.	Connect the cable to the speaker jack on the IC-701PS.
	The internal speaker cable is not connected.	Connect the speaker connection.
	A headphone is connected to the PHONES jack.	Unplug the headphone.
4. Sensitivity is low and only strong signals are audible.	RF GAIN Control knob is turned fully Counterclockwise.	Turn the RF Gain control knob fully clockwise.
	The antenna feed line is cut or shorted.	Check the feed line and correct any improper condition.
5. During receive, the "S" meter is higher than the "0" position even when there is no signal.	RF GAIN Control knob is turned fully counter clockwise.	Turn the knob fully clockwise.
6. Only incomprehensible voices are heard during SSB reception.	Receiving the wrong sideband.	Set the MODE switch to the sideband other than the one you are using, either USB or LSB.
7. The tone of the received signal is very high or low pitched.	Maladjustment of the P.B. Tune control.	Set the P.B. Tune control knob to the center (12 o'clock) position.
8. No output power or low output power.	The COMP Control knob is set too low when the Speech Processor is ON.	Turn the Speech Processor OFF, or turn the COMP Control knob clockwise to obtain the proper output power.
	MIC GAIN setting is too low.	Turn the MIC GAIN Control clockwise to the center (12 o'clock) position.
	When SSB is desired, but the MODE switch is in the CW or CW-N position.	Set the MODE switch to the SSB (USB or LSB) position.
	PTT switch is not functioning due to improper connection of the mic connector.	Using a screw driver, slightly spread the prongs of the mic connector for better contact.
	The antenna feed line is cut or shorted.	Check the antenna feed line and correct any improper connection.
9. The Po meter does not function when signals are transmitted.	The SWR switch is set at the SWR position.	Open the Access Cover and move the SWR switch to the SWR SET position.
	SWR SET control is not set at the proper level.	Open the Access Cover and turn the SWR SET control clockwise while watching the Po meter, until the needle moves properly.
10. The receive mode functions properly and your signals are transmitted, but you are unable to make contact with another station.	The VFO Select is in the RA-TB or TA-RB position.	Set the VFO Select switch to the A or B position.
	The receive frequency is offset from the transmit frequency by the RIT control.	Turn OFF the RIT, or set the RIT control knob to the center (12 o'clockw) position.

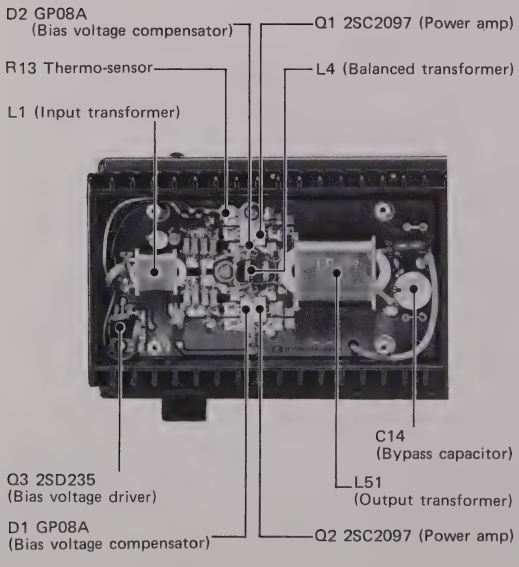
Problem	Possible Cause	Solution
11. The left side of the unit case becomes a little hot.	As the left side of the case is used as a heat sink for the transmitter driver transistor, even during normal operation, it may get as hot as 35°C (63°F) above room temperature.	Make sure that the area around the unit has as much ventilation as possible.
12. The heat sink on the rear panel becomes hot.	The heat sink on the rear panel is for the final transistors and may become as hot as 40°C (72°F) above room temperature.	Make sure the area around the unit has as much ventilation as possible.
13. Hot air suddenly or occationally eliminates from the heat sink on the rear panel.	The cooling fan has been automatically triggered ON due to the temperature of the final transistors.	This is a normal condition and you may continue operation. However, if the fan starts running at high speed and the frequency display LED's and meter lamps start blinking, discontinue operation immediately, allow the heat sink to cool and check to see that you have the best ventilation possible, or correct a high SWR condition, etc.
14. Frequency display LED's and the meter lamps start blinking, and the fan starts running at high speed.	Insufficient ventilation of the heat sink on the rear panel. Long operation on RTTY or CW. Excessive antenna SWR.	Make sure the heat sink on the rear panel has as much ventilation as possible, after stopping transmit operation and allowing the heat sink to cool. Reduce the RF output power by turning the COMP control knob counterclockwise, or set the unit in the receive mode as quickly as possible. Check the antenna feed line and correct any improper condition of mismatch.
15. The RIT LED goes out even though you did not depress the RIT ON/OFF switch to turn it OFF.	The RIT is automatically turned OFF when the Tuning Knob is rotated. The Power switch has been turned OFF,	You may change the unit so that the automatic RIT OFF function does not operate when you rotate the Tuning knob. (See page 13.) Depress the RIT ON/OFF switch again to turn ON the RIT.
16. The frequency does not change by rotating the Tuning knob.	DIAL LOCK is engaged.	Disengage the DIAL LOCK by pressing the DIAL LOCK button.
17. The scale on the Tuning knob is not in calibration with the displayed frequency.	The DIAL FAST button was depressed when the Tuning knob was set with one of the small increments at the center point, the Tuning knob was rotated when the DIAL LOCK was engaged, or the dial was rotated beyond the band edge.	Set the Tuning dial so that one of the large increments is at the center point, and push the DIAL FAST button TWICE, and the scale will be calibrated.
18. The last two digits of the memorized or displayed frequency has changed to 0.0.	The DIAL FAST button was pressed, or the VFO Select switch was turned while in the DIAL FAST mode.	Release the DIAL FAST function by pressing the DIAL FAST button again, and set the unit to the desired frequency with the Tuning knob.
19. An abnormal figure is displayed on an LED, or an LED fails to illuminate.	The Power switch was turned OFF and ON too quickly.	Turn the Power switch OFF, wait a few seconds, and then turn it ON again.
20. An unusual amount of distortion and/or noise in the transmit signal.	The MIC GAIN is too high when the RF Speech Processor is ON.	While watching the meter in the COMP mode, turn the MIC GAIN control counterclockwise so that the meter indicates approximately 0 dB at the voice peak.
21. Unable to key when using an electronic keyer.	The Switching circuit of the electronic keyer does not close completely. Polarity of the connection wires from the keyer is reversed. The MODE switch is not in the CW or CW-N position.	Replace the keyer with one having a voltage of less than 0.4V between the two keying lines at the key down position, or modify your keyer so that the voltage is less than 0.4 Volts. Connect the keyer wires observing proper polarity. Place the MODE switch in the CW or CW-N position.

SECTION 9 INSIDE VIEW

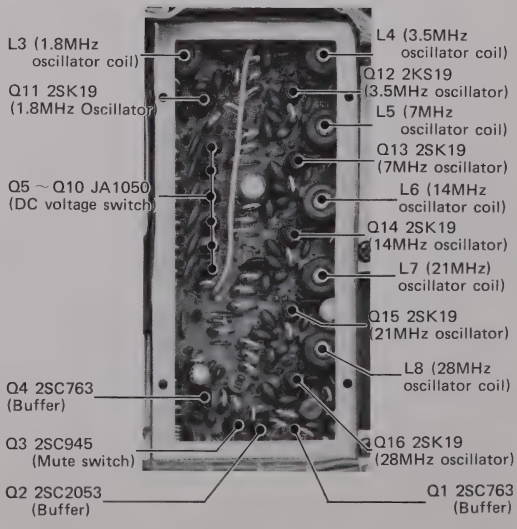
9 - 1 TOP VIEW



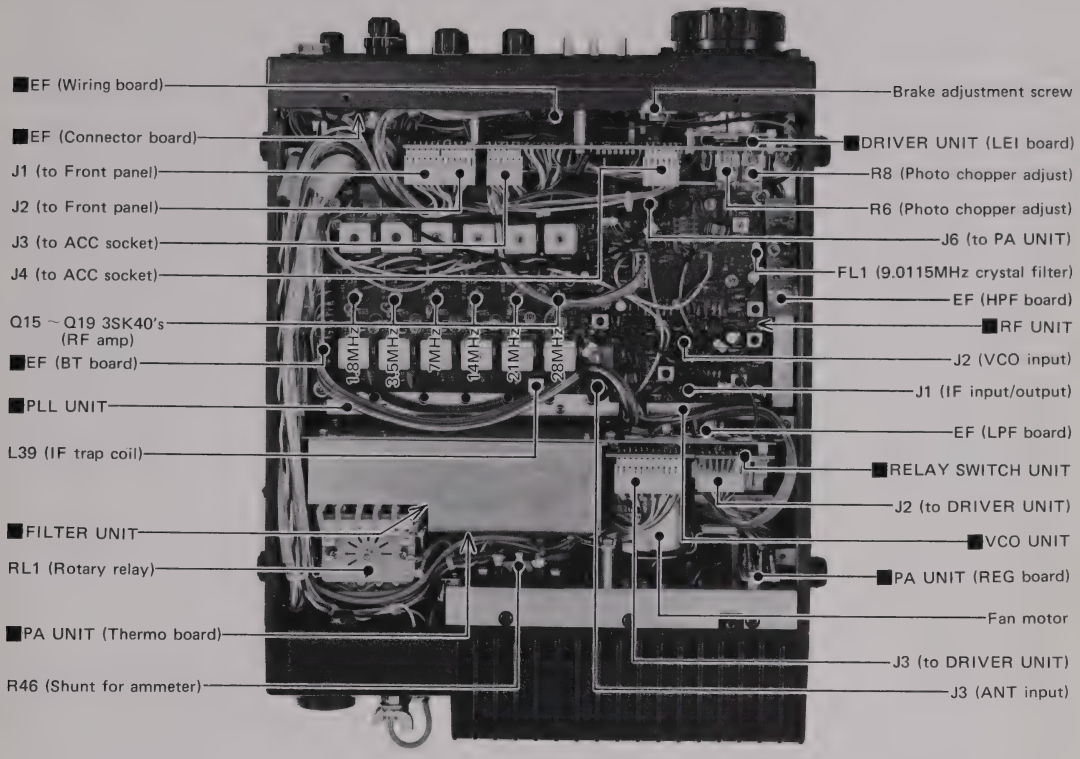
9 - 2 PA UNIT



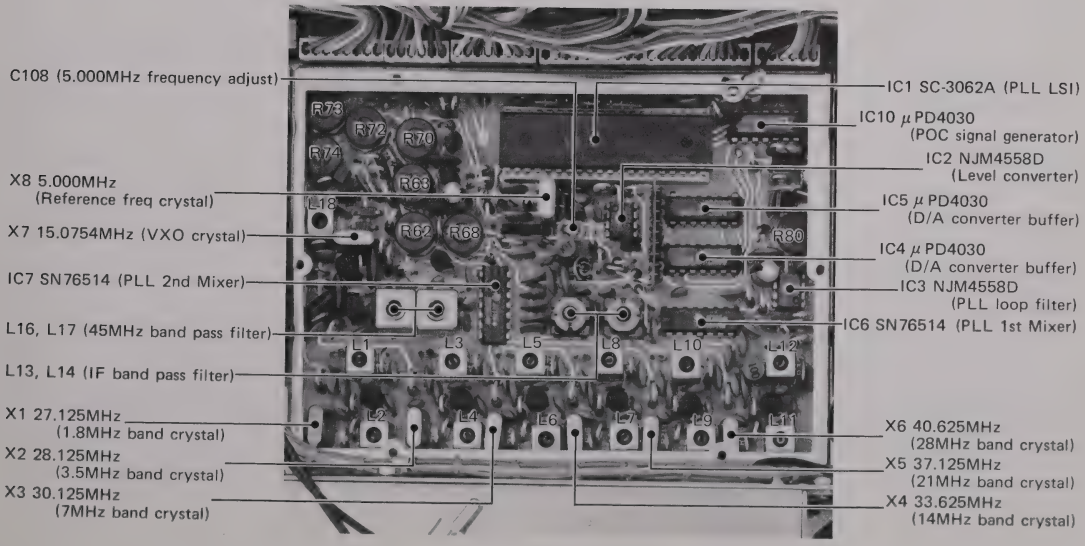
9 - 3 VCO UNIT


L3 (1.8MHz oscillator coil)
Q11 2SK19 (1.8MHz Oscillator)
Q5 ~ Q10 JA1050 (DC voltage switch)
Q4 2SC763 (Buffer)
Q3 2SC945 (Mute switch)
Q2 2SC2053 (Buffer)
L4 (3.5MHz oscillator coil)
Q12 2KS19 (3.5MHz oscillator)
L5 (7MHz oscillator coil)
Q13 2SK19 (7MHz oscillator)
L6 (14MHz oscillator coil)
Q14 2SK19 (14MHz oscillator)
L7 (21MHz) oscillator coil)
Q15 2SK19 (21MHz oscillator)
L8 (28MHz oscillator coil)
Q16 2SK19 (28MHz oscillator)
Q1 2SC763 (Buffer)

9-4 BOTTOM VIEW



9-5 PLL UNIT



SECTION 10 VOLTAGE CHARTS

10 - 1 - 1 "A" UNIT TRANSISTORS

	TRANSMIT				RECEIVE				
TR No.	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	REMARKS
Q 1	2.2		6.9	1.5	2.2		6.9	1.6	USB COMP ON
Q 2	1.7		6.6	1.2	1.7		6.6	1.2	"
Q 3					0.6		1.1	GND	NO SIGNAL INPUT
Q 4	–3.3		6.7	GND					COMP ON
Q 5	0		5.7	GND	0.7		0.2	GND	VOX ON CW KEY ON
Q 6	5.7		6.2	5.0	0		6.4	0	"
Q 7					0.5		2.9	1.3	NO SIG INPUT VOX ON
Q 8					1.9		1.4	1.3	"
Q 9					0.3		8.2	GND	"
Q10					0		5.9	0	
Q11	0	4.4	7.1	0.6	0	3.7	7.2	0.6	COMP ON
Q12	0	4.4	6.9	0.2	0	3.7	7.0	0.2	"
Q13	0.6		2.3	GND					
Q14	0		2.3	GND					
Q15	6.0		4.8	6.7	6.0		4.8	6.7	
Q16	5.6		6.0	5.5	2.6		6.0	5.5	
Q17	3.8		3.4	3.4	3.8		3.4	3.4	
Q18	2.6		3.3	1.4	2.6		3.3	1.4	
Q19	5.4		6.0	5.0	5.4		6.0	5.0	
Q20	6.0		4.7	6.6	6.0		4.7	6.6	
Q21	0		6.6	0	0		6.6	0	NO SIGNAL INPUT
Q22	0		0	6.6	0		0	6.6	
Q23	6.6		0	6.6	6.6		0	6.6	
Q24	0		6.6	0	0		6.6	0	
Q25	0		6.6	0	0		6.6	0	
Q26	1.5		4.7	1.0	1.5		4.7	1.0	
Q27	4.5		7.6	3.9	4.5		7.6	3.9	
Q28	–4.8		0.5	–5.5	–4.8		0.5	–5.5	
Q29	–8.5		8.0	–9.0	–8.5		8.0	–9.0	
Q30	–9.0		–3.0	–9.0	–9.0		–3.0	–9.0	
Q31	–8.5		–9.0	–9.0	–8.5		–9.0	–9.0	
Q32	–8.6		8.0	–9.0	–8.6		8.0	–9.0	
Q33	–9.0		8.0	–7.5	–9.0		8.0	–7.5	
Q34	–7.9		4.4	–8.5	–7.9		3.9	–8.5	
Q35	–8.5		–9.0	–9.0	–8.5		–9.0	–9.0	
Q36	5.5		–9.0	4.4	3.4		–9.0	3.9	
Q37					8.8		12.9	8.2	
Q38	0.7		8.8	0.3	1.7		1.0	0.8	
Q39	8.7		12.8	8.0					
Q40	12.8		8.0	13.4	12.8		8.0	13.4	
Q41	0		5.0	0	0		5.0	0	
Q42	0.5		12.5	GND	0.6		0.5	GND	
Q43	0.6		0.5	GND	0.5		12.8	GND	
Q44					3.3		4.4	2.8	
Q45					4.8		2.6	4.8	
Q46					2.6		4.8	1.9	

10 - 1 - 2 "A" UNIT IC IN TRANSMIT MODE

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC1	1.5	1.5	E	6.3	6.3										COMP ON
IC2															
IC3	0	7.0	6.3	3.5	2.3	GND	0	0	2.3	3.5	3.5	3.5	6.3	0	COMP ON
IC4	0	7.0	6.3	3.5	2.3	GND	0	0	2.3	3.5	3.5	3.5	6.3	0	COMP ON
IC5	1.8	1.1	1.1	1.8	1.2	6.9	0	3.4	0	3.4	3.4	6.9	0	GND	
IC6	0	0	0	–9	0	0	0	8.0							

10 - 1 - 3 "A" UNIT IC IN RECEIVE MODE

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC1															
IC2	3.7	1.5	GND	1.0	3.7	5.8	4.3	4.6							
IC3	0	7.1	6.4	3.5	2.3	GND	0	0	2.3	3.5	3.5	3.5	6.4	0	
IC4	0	7.1	6.4	3.5	2.3	GND	0	0	2.3	3.5	3.5	3.5	6.4	0	
IC5															
IC6	0	0	0	–9	0	0	0	8.0							

10 - 2 - 1 "B" UNIT TRANSISTORS

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1	1.2		13	0.5					
Q 2	0.6		16.7	GND					
Q 3	0.6		16.7	GND					
Q 4	0.7		0	GND					
Q 5	12.7		13.9	13.5	17.0		–8.0	17.0	
Q 6	0.7		0	GND					28MHz
Q 7	1.6		3.3	0.5	1.6		3.3	0.5	CW MONI
Q 8	0		0.4	GND	0		0.4	GND	
Q 9	1.3		13.8	0.7					
Q10	0		–9.0	0					
Q11	0		–8.5	0.5					
Q12	–8.5		1.5	–9.0					
Q13	1.5		–9.0	2.0					
Q14					1.0		13.7	3.4	DIM ON
Q15					4.0		5.2	3.4	"
Q16					5.2		14.0	5.7	"
Q17	0.4		0	0.5	6.3		5.8	7.1	SSB NO SIG INPUT
Q18	2.2		7.0	1.7	2.2		7.0	1.7	
Q19	2.3		7.0	1.7	2.2		7.0	1.8	
Q20	0.6		4.0	GND					RTTY N
	0.6		7.6	GND					RTTY W

10 - 2 - 2 "B" UNIT IC IN TRANSMIT MODE

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC 1	1.9	14	14	0	0.5	14.1	0	4.2							

10 - 2 - 3 "B" UNIT IC IN RECEIVE MODE

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC 1	1.9	14	13.4	7.9	6.7	14.1	0	0.9							

10 - 3 RF UNIT

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1	3.9		6.8	3.9					
Q 2	0.5		0	0.5	7.3		7.9	8.1	
Q 3					2.9	0	6.8	0.5	
Q 4	0.2		8.0	GND					
Q 5	0.7		0	GND					
Q 6	1.1		6.4	0.2					
Q 7					0		8.0	0.4	
Q 8					0		4.1	0.4	NB ON
Q 9 (1)					2.5		5.7	1.9	,,
Q 9 (2)					2.5		6.4	1.9	,,
Q10 (1)					2.5		6.4	1.9	,,
Q10 (2)					2.5		7.2	1.9	,,
Q11					0		2.5	GND	,,
Q12					0		2.7	GND	,,
Q13									DELETED
Q14									DELETED
Q15	0	2.8	7.8	1.1	0	2.8	7.9	1.1	
Q16	0	2.8	7.8	1.1	0	2.8	7.9	1.1	
Q17	0	2.8	7.8	1.1	0	2.8	7.9	1.1	
Q18	0	2.8	7.8	0.7	0	2.8	7.9	0.7	
Q19	0	2.8	7.8	1.0	0	2.8	7.9	1.0	
Q20	0	2.8	7.8	0.8	0	2.8	7.9	0.8	

10 - 4 RELAY SWITCH UNIT

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q1 (1)					*		6.2	3.6	7MHz
Q1 (2)					*		6.4	3.6	,,
Q2					6.2		8.0	6.4	
Q3					6.4		8.0	6.2	
Q4					▲		8.0	8.1	
Q5					▲		7.4	GND	
Q6					0.7		0	GND	
Q7					0.1		16.4	0.1	
Q8					0.1		16.2	GND	

* High impedance: multimeter does not indicated actual voltage.

▲ Pulse activated

10 - 5 PA UNIT

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE 1	GATE 2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1	0.7		16.0	GND					PA BOARD
Q 2	0.7		16.0	GND					,,
Q 3	1.3		16.0	0.7					,,
Q 4	7.5		8.0	7.9					THERMO BOARD FAN OFF
Q 5	8.0		8.0	8.0					,,
Q 6	7.9		13.9	GND					,,,
Q 7	13.9		0	13.9					,,
Q 8	7.5		8.0	8.0					,,,
Q 9	8.0		13.9	8.0					,,
Q10	13.9		0	13.9					,,
Q11	0		0	GND					,,
Q12	0		0	GND					,,
Q13	0.7		0.8	GND					REG BOARD
Q14	0.6		12.2	GND					,,
Q15	15.8		14.2	16.6					,,

IC-701 BLOCK DIAGRAM